MAY, 1940

The TOOL ENGINEER

Official Publication of the

AMERICAN SOCIETY OF TOOL ENGINEERS

STANDARD AGD

DIAL INDICATORS

WITH

SHOCKPROOF MECH-

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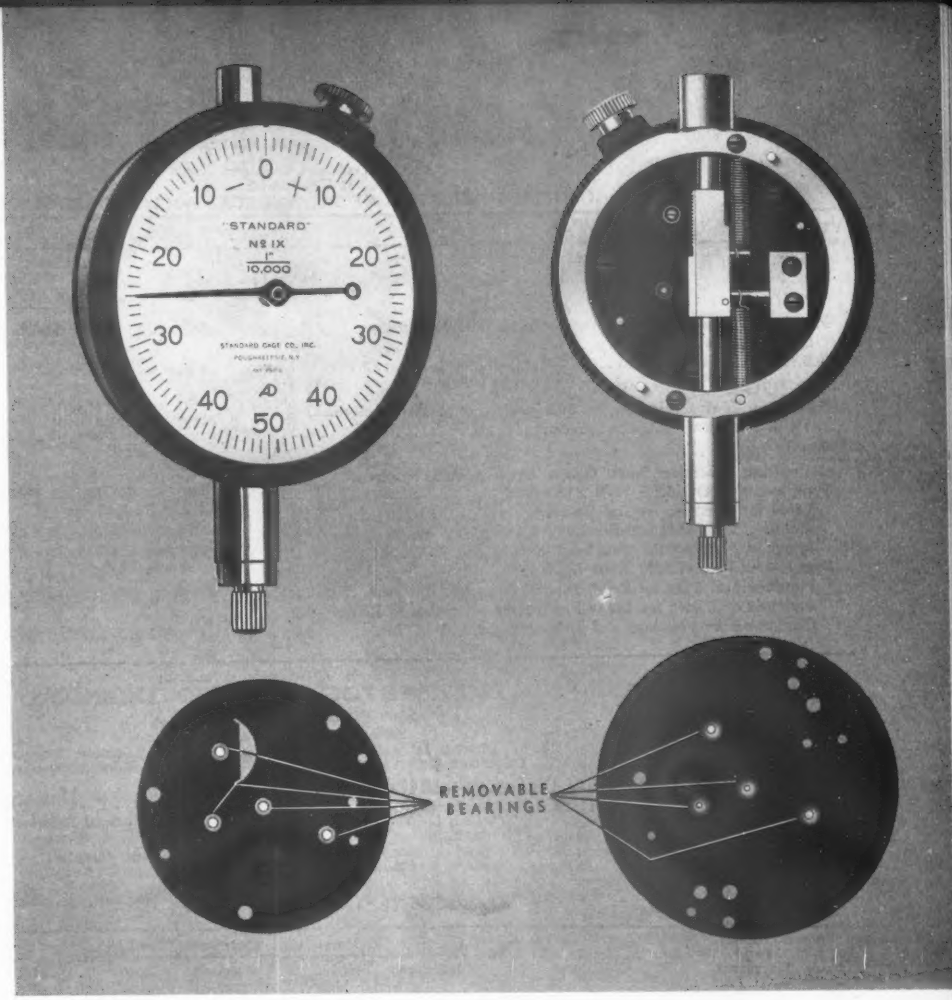
AND REMOVABLE

GEAR BEARINGS



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Go South Young Man!

AN EDITORIAL

By A. E. RYLANDER

WITH a pan-American union in congress at time of writing, we can well outline definite plans for cementing friendship and commercial relations with our South American neighbors. For, whether the European war will last until 1947, as some predict, or the battle in Scandinavia decides the issue between rival empires and results in a truce, peace must inevitably follow war. It always does. And when it does, each belligerent is faced with the problem of providing employment for its legions; it will be a case of "Buy British," "Buy French," "Buy German." Our temporary boom will collapse unless, during hostilities, we broach other markets. Our second basket of eggs lies "South of the Border."

It may be contended that South America is an agricultural and stock raising area. That is true, in part. But it is also rich in minerals and timber, and, in the modern tempo, each industry requires machinery and equipment for competitive handling. There is no reason to believe that South America will be long satisfied to lag behind United States packing, food processing, mining and lumber industries. Here are markets on a grand scale, in which we have decided advantages over European competition.

But these are not all, for South America is rich in potential hydro-electric power, a field in which, so far, Sweden and Germany have led in developing. There is no object in building generating plants unless there be potential consumption of power; that implies radios and telephones, the gamut of household, agricultural and industrial electric appliances. And most of all, there are the "luxuries" which, to us, have become essentials in the scheme of living, but which are yet to be enjoyed by the masses, South of the Rio Grande.

With South Americans building roads, and the pan-American Highway interlacing the continents, there will be a further salutary demand for automobiles. In "Production Perspectives," April TOOL ENGINEER, there was an account of an American automobile concern which is erecting a large plant in Argentina. This straw in the wind is indicative of what the G. M. colossus thinks of South America's future. And where there are automobiles there will be expansion, the demand for road building equipment and materials. Automobile plants presume supply plants, tool and machine shops, augur well for an extension of A.S.T.E. Chapters into Latin America. Why not?—let's grow along with the southward trend of industry.

Last but not least, let us play the game on the level with our friendly neighbors; let there be no exploitation that, in later years, we may have to apologize for. Rather, let us have the same reciprocal dealings which have done so much to cement our friendship with Canada, a reciprocity which has materially benefitted both sides of the northern border. And now, young man, go South!—the future security and prosperity of the Americas can be assured by friendly hands across the Isthmus.

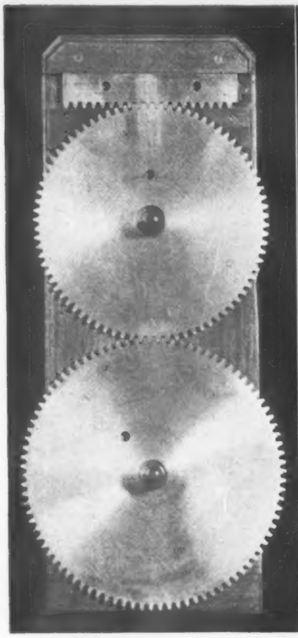
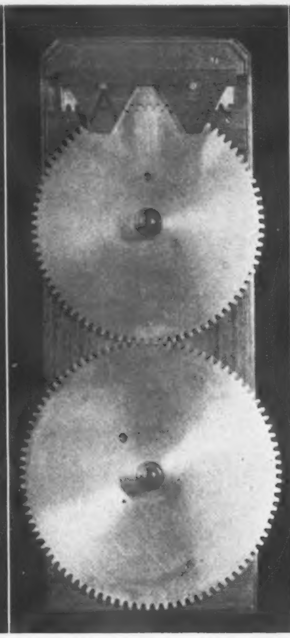
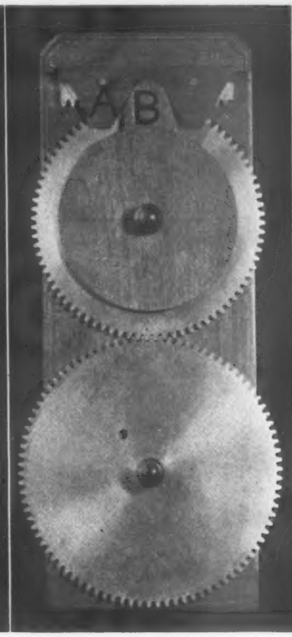
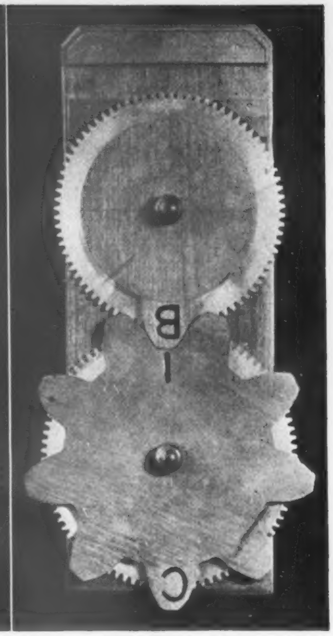
   

Figure 1. **Figure 2.** **Figure 3.** **Figure 4.**

Above is shown the model prepared by the author to demonstrate the fundamentals of correct gear teeth.

Generating Small Precision Gears

By ARNOLD THOMPSON
CHIEF TOOL ENGINEER
CANADIAN ACME SCREW & GEAR LTD.
TORONTO, CANADA

THE term "generating" as applied to gear cutting is often misused. Few machines truly "generate."

A fundamental of gear generating is that the equipment can demonstrate the cutting of theoretically correct gears with a single tooth form cutter as well as with multi-tooth cutters also, without indexing.

Small and large gears can be precision cut by any of the modern methods, provided that the necessary precision is inbuilt into the equipment, and that this precision can be maintained.

Most makes of gear cutting equipment depend on such precision. Therefore the first cost is high and maintenance costly. Can this cost be reduced and gears made better and faster?

To solve such problems the Tool Engineer must know each factor, analyze them, and co-ordinate them with the fundamentals of physics. Let us consider the essentials of gear tooth generating by means of the model, Figure 1.

It consists of a sliding member 1 and two rolling blanks 2 and 3 for mating gears of the desired ratio, in this case 8 and 9. (The teeth are only to help rolling.) On the sliding member is mounted the basic tooth form desired "A", Figure 2. On rolling blank 2 is mounted a gear blank "B", Figure 3. Sliding and rolling will generate from "A" one correct tooth form on "B."

Most of the functions of gear teeth can be demonstrated with this model but, the immediate use is to demonstrate gear tooth generating, copy reproduction, and the hunting tooth principle so essential for precision gears.

By reversing "B", any error in tooth form of "A" is demonstrated by the symmetry or otherwise of the tooth form "B", Figure 3.

To demonstrate copy reproduction and the hunting tooth principle remove the sliding member "A". Mount blank "C" on 3. By revolving, tooth "B" will generate progressive teeth on blank "C" till the 9 teeth are formed. (Figure 4.)

The odd tooth ratio and progressive action (or hunting tooth principle) generates the teeth on blank "C" equally formed and equally spaced—a major essential for precision gears.

If this principle of developing can be applied to cutting teeth on a machine, it will be truly generating. This principle was used 40 years ago for generating the Lanchester car, rear axle, globular worm and wheel drive. The fundamental principles used still hold good. Time does not change them. They are equally true of large and small gears. Application of these principles for cutting, spurs, helicals, spirals, worms, and worm wheels follow.

There are two fundamental methods of cutting teeth. One by reciprocating, like shaping, the other by rotating, like milling or hobbing.

When you reciprocate, you use less

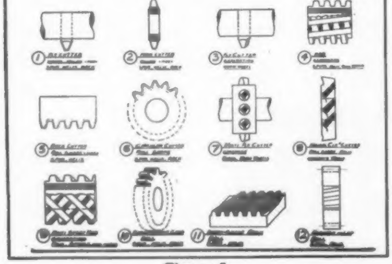


Figure 5

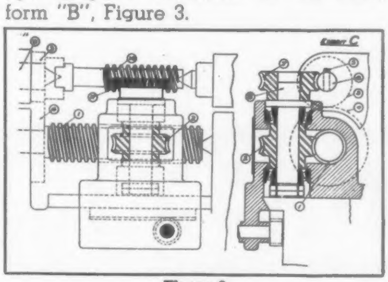


Figure 6

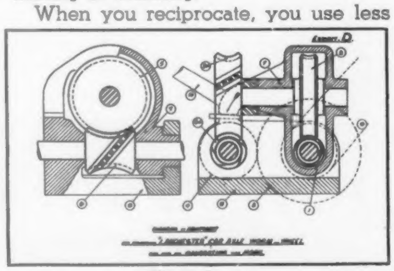
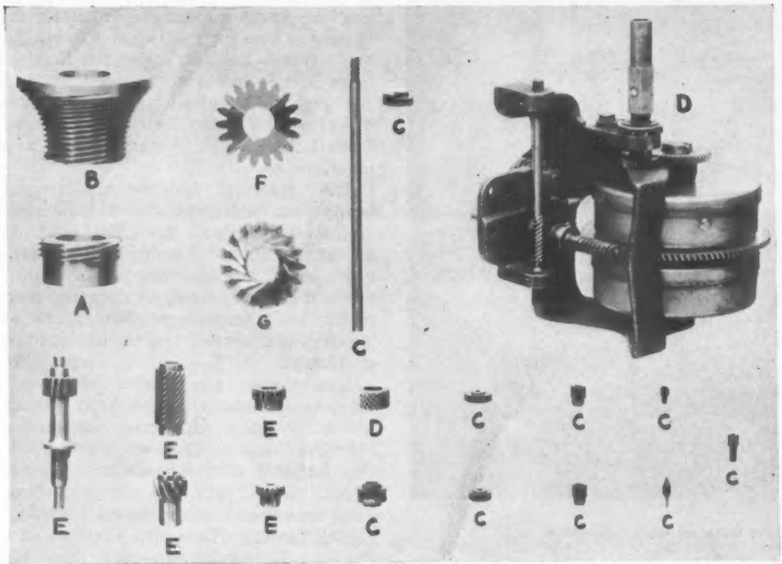


Figure 9



than half of the cycle for cutting the gear. When you rotate, you use nearly all of the cycle. Rotating is also the ideal method for generating.

Figure 5 shows diagrams of most of the cutters in use for cutting and finishing gear teeth. They are arranged in some chronological order and are self explanatory.

Note the similarity of a multi fly cutter, to a Fellows type helical cutter, and its likeness to a hob. Also the evolution of a burni-shave cutter, from a form milling cutter.

An application for generating worms and wheels is illustrated by Figure 6. This method is copy generating. The essentials are:

A lead screw—1; an engaging worm wheel—2; the ratio gears—3 and 4; means for driving, feeding and adjusting. Note only 3 gears and lead screw are required.

A flycutter 5 in arbor 6 driven by spindle 9. A worm wheel blank 7 mounted on mandril 8, and the set-up is complete for cutting worm wheels. Run at a suitable speed and traverse feed the fixture. The feed does not have any relation to the drive, can be rack, screw or cam, hand, power or hydraulic operated. One pass will generate a perfect worm wheel. A single flycutter is slow but a multiple flycutter or hob will produce in the best time.

A similar set-up is used for cutting the mating worm. Mount a suitable flycutter on the worm wheel spindle 8, the blank 10 between the centres, and one pass will generate a perfect worm. For faster production, use a multiple flycutter 11 or a solid cutter of the Fellows type. There are limitations to the variety of worm wheels that can be cut on one such equipment this way, as the essential feature for operating is, that the pitch diameter of the worm wheels must be the same. The pitch diameter of the worms can be anything in the range of the design.

It is not necessary to have a special machine for this as the fixture can be adapted to a lathe or milling machine.

Above Figure 8, showing various types of gears discussed here. Right, Figure 7, showing fixture for lathe for gear production.

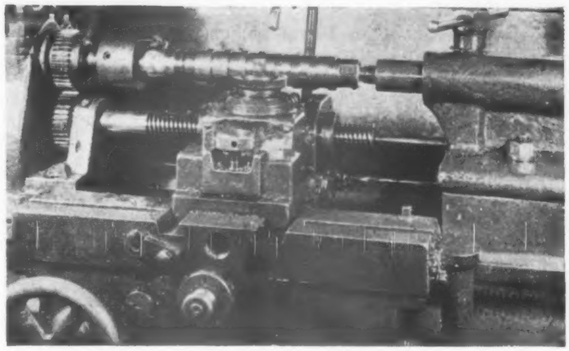


Figure 7 is a photo reproduction of such a fixture applied to a lathe for producing speedometer drive gears for automobiles.

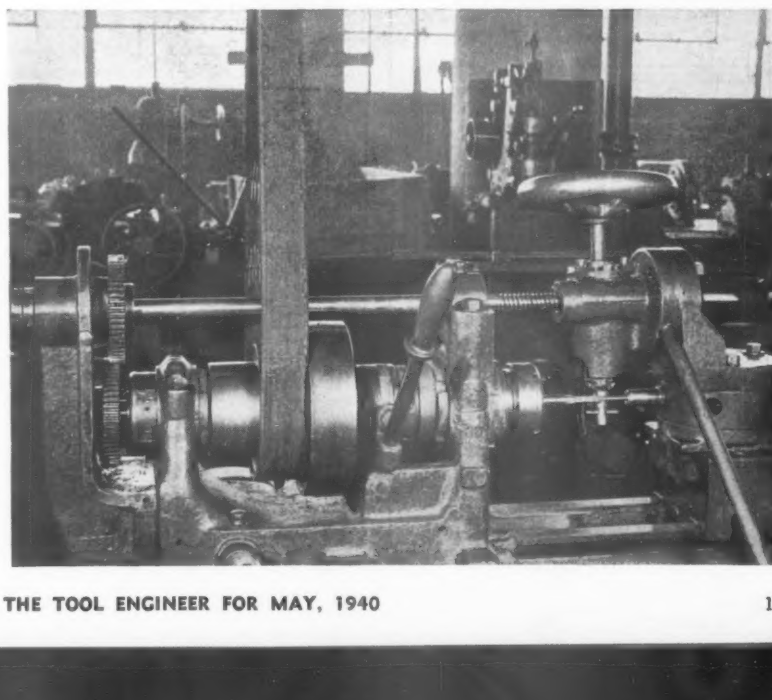
Change the lead screw, worm wheel, ratio gears and cutter, then any pair of worms and wheels within the range of the machine can be produced.

Right or left hand, 1, 2 or more starts, any number or form of teeth; the essential being that the master worm wheel and the generating cutter be of the same pitch diameter. A special sample (Figure 8B) cut on this set-up demonstrates the "Hour Glass" worm.

The four hobs (two rough and two finish), are used for rough and finished hobbing the actual worms and wheels, using unskilled operators. The worms were case-hardening steel and the worm wheels of phosphor bronze.

At the time this principle was used in the Lanchester plant, with limited tool room equipment, and compared with the gear cutters of that time, the cost of such a set of hobs seemed high. In comparison with present day cutters, shavers, lapping, measuring and testing equipment, it is now apparent that it was very economical. The method is so efficient that it is presented with the thought that designers of small

Figure 10. A turret lathe performing second operation of cutting teeth.



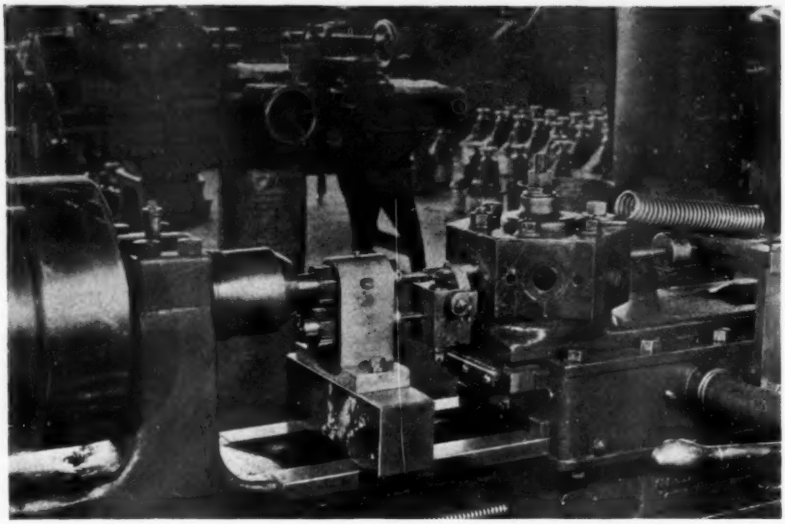


Figure 11, showing the use of a turret lathe for gear production.

precision gears will co-operate with Tool Engineers to produce similar gears by this method.

Cutting Gears on Turret Lathes

There are many ingenious devices for cutting gears on turret lathes and automatic screw machines at same time blank is produced. (Fig. 8). (C) The success and economy of the method depends on conditions, the cost of the machine for cutting the teeth as a secondary operation having to be duly considered.

Figure 10 is a photographic reproduction of a turret lathe performing the second operation of cutting teeth on worm and wheel.

Figure 11 shows another application.

Figure 12 is a diagram of Figure 10 showing how the worm can be turned, thread generated and cut off on a screw machine.

Figure 9 is a diagram of the Lanchester method. It is fundamentally the same as Figure 6 with an in feed instead of a traverse feed. It does not have the restrictions as to pitch diameter. It can hob a conventional worm wheel, but will only cut the "Hour Glass" type of worm.

Studying the diamgram it will be seen that precision worm 1 is geared with a precision worm wheel 2 by ratio gears 3 and 4. The blank worm wheel to be cut is mounted at 5 and suitable cutter is mounted at 6. If a worm is to be cut, it is mounted at 6A and a suitable cutter is mounted at 5A. Frame 7 carries 2 and 5 and swings about centre 1 in a base 8 that carries 1 and 6. Ratio gearing connects 1 and 6. Power is applied at 9 and cutter fed into stop.

The method used for making cutters 5A and 6 is very interesting. The generating of the cutter teeth being done on the same machine.

1st Step—A flycutter of the desired form is mounted at 6. A cutter blank with insert blades is mounted at 5. The teeth generated by feeding in. The blades are removed, backed off, hardened, ground, and reinserted into blank. This is now the roughing hob for worm.

2nd Step—Place a cutter blank with insert blades at 5A. Generate feed in the roughing hob as above made. Follow the same procedure to make the roughing hob for the worm wheel. Use these rough hobs to make the finished hobs in like manner.

Figure 13 is a diagram showing how a worm wheel can be drilled, formed, teeth hobbed, and cut off on a screw machine.

The essential feature of all such equipment being to harmonize the work spindle speed with the cutter and use the above stated principles of generating, copy reproduction and hunting tooth. If quantity justifies a special automatic machine for cutting teeth as an integral operation, it will certainly show economy.

Some years ago, while considering ways and means for making Phono-Motor Gears, a Universal Generating Machine was built. (See Figure 14). This hobbed all the gears on a Phono-Motor. (See Figure 8). Later it was used for experimenting with Cross Axis Shave Cutters. (Note the shaving of a Cluster Gear in Figure 14). This is a basic design for a Universal Generating Precision Gear Machine for large or small gears, spurs, helicals, spiral worms and worm wheels. Figure 15 is a diagram of the design.

A precision worm 1 and wheel 2 through ratio gears 3 and 4 revolve gears 5 and 6 on which is mounted cutter 7. These can swing in casing 8 through 360° with relation to bracket 9, capable of adjustment on bed 10 and driven by bolt and pulley 11. In worm wheel 2 is a nut 12 through which can slide a lead sleeve 13 which also can revolve spindle 14 on which is placed gear blank 15 that is to be cut. These are mounted in headstock 16, capable of traversing on bed 10.

Note only 6 gears and lead cam essential.

It is a simple harmonic generating set-up, very flexible and easy to manufacture. The desired lead precision is in-built into the lead sleeve and nut constructed like a sliding spline, being parallel to the axis for cutting spurs. Right or left hand for cutting helicals. All forms of generating cutters can be used by it:—Flycutter, Single Hob, Multi Hob, Circular Generating Cutter, Burni-Shave, Burnishing Roll, alo Laps.

The best set-up for cutting precision gears is:—

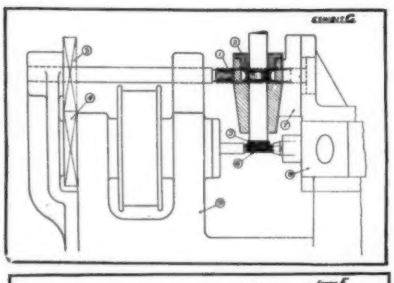
1st—Hob as close to size as practical on one of these generating machines.

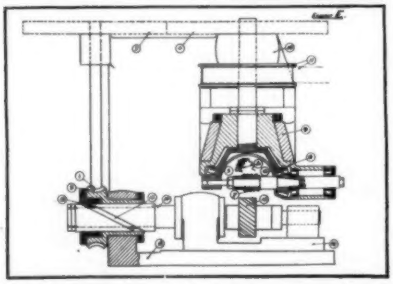
2nd—Finish with a shaving cutter on a similar machine. Both identical lead cams.

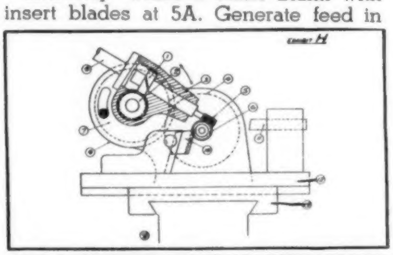
A Burni-Shave Cutter is costly but on this controlled generating machine, a simpler type of cutter for shaving can be used which may be termed a Gener-Shave Cutter. Figure 8(F)(G). It uses the cross axis cutting principle (Figure 16). The cutter looks like a gear, there being no apparent cutting angle, rake, backing off or clearance. The front edge, however, cutting like the multi edges of the Burni Shave Cutter.

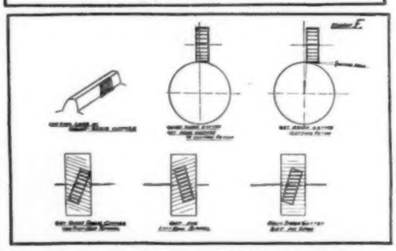
This is an answer to the question

(Continued on page 65)









Left upper—Figure 12, Lower— Figure 15. Right upper—Figure 13. Lower right—Figure 16.

TOOLING FOR PLASTICS

A Symposium on the Subject as Given Before a Technical Session, March 7th, 1940 in New York City, National Annual Meeting, A.S.T.E.

Tools for Plastics

By JOE STEWART

GENERAL FOREMAN, PLASTICS DEPARTMENT
FORD MOTOR COMPANY, DEARBORN, MICH.

TOOLS and machines for Plastics. Plastic Materials to be used with these machines and tools. What tools and machines do you need? Ask the tool and machine makers. What plastic materials do you need? Ask the laboratories. And the users of these tools, machines, and plastic materials counter with, what have you to offer in the line of tools and machines, and will your plastic materials meet the requirements of industry today? For as the plastic industry is growing by leaps and bounds, everyone concerned in the industry is anxiously striving to promote and bring forth new ideas, new methods of producing better materials and molding better parts, improved machines, and more flexible tools to make and finish the parts, and most important of all to acquaint more people with the possibilities that lie ahead of us in the use of plastic parts. Cooperation in all branches of industry to promote the use of plastics, will create a need for more and more types of tools and equipment and bigger and better machines. Then there will be no reason to doubt that the plastic industry will take its place among the topmost industries of the Nation. Now let us consider these questions in a series of word pictures and try to portray what it is all about.

Type of Plastic to Use

A Company is going to put a new product on the market. They want to make this product attractive to the consumer. They want something that will be economical, easy to make, attractive in coloring and design and durable. After looking over the field of raw materials they decide to use plastics for their product. Now comes an important question to decide. What type of plastic to use? As there are many types of plastic materials on the market today, care should be used in the choice of the type of material best suited to make the parts. In selecting the plastic material the following questions should be considered.

Is the part to be used inside, where it is protected to a considerable extent or outside where it is exposed to the weather, sun, dust and other abuses?

Should the surface be hard or of a softer finish?

Is it to be used as an electrical insulator needing a high dielectric strength?

Must it resist high temperatures or low temperatures?

Is it just an ornament for decorative purposes only or is it a working part?

Should the color be brilliant or subdued, light or dark, fast—or of no consequence?

Will it be subjected to much moisture or will it be kept dry?

Will it be subjected to corrosive chemical contacts or not?

Will it be used in or about oils?

Should it be transparent, translucent, or opaque?

Should it have a high impact strength?

If parts, like toys, should be made from plastics would it harm the baby if he put it in his mouth to bite on it?

And perhaps you could add a few more questions to this list that should be considered. However, now that we have considered these questions we will consider two types of material selected, one that will be molded in the compression form and one that will be molded in the injected form. The first will be of the thermo-setting type of plastic and the latter of the thermo plastic type. The Thermo-setting type of material is one that when once cured has no salvage value if scrapped, that is, it can only be molded once. The Thermo-plastic type of material is one that softens under heat and has a salvage value in that it may be used over again.

Design of Part—Important

Now the part designer steps into the picture. His duties are of vast importance to the part for it is really up to him whether the part can be of pleasing appearance and can be molded readily and without undue trouble. The Designer must use care that all sections of the part are as uniform as possible, for heavy and thick sections are to be avoided as they tend to produce shrink spots and chill lines in the thermo-plastic materials and a uniform curing in the thermo-setting materials.

Draft must be considered and—as much as possible—allowed so that the part can be ejected from the mold freely.

One of the great faults of the designer today is to design a part, formerly made from metals requiring several operations to make, the same as the metal one and expect the molder to make it in one operation.

The use of inserts should be studied with care and whenever possible assembled after the part is molded. As a molding press is a valuable and costly piece of equipment, the time lost in loading inserts cannot be redeemed. The inserts may be inserted more profitably after the part is nearly finished thus cutting down the added labor of removing the insert in case the part is defective. In thermo-setting materials, however, this is practically impossibie as the materials are too hard to allow the inserts to be pressed into place without cracking. The part should be designed if possible to avoid the use of cam molds, or other mechanical acting molds other than the natural opening and closing of the press.

Type of Press and Mold?

Now we pass on to the mold designer. And again a series of questions must be brought before us.

What type of press to use? Tonnage of the press, area of the platens, opening of press with press open, stroke, and possibility of both top and bottom knockouts? From this information the size of the mold may be computed and the number of cavities in the mold be selected.

Next, what type of mold to make? Usually three types of molds are considered, namely, the flash type, the semi-positive type, and the positive type. The flash type is one which comes together at the parting line of the part and allows the surplus material to escape or flash off readily. The semi-positive type is that whose flash or parting line is located below the surface of the mold in a pocket or well and when the mold closes the upper part of the mold traps the material in the cavity and forces it into every part of the mold. However, the sides of the well are tapered slightly to permit the surplus material to ooze out. Greater pressure is required to flash a mold of this type than the flash type. The positive type mold is one where the material is entirely trapped and held in the mold without flashing. A definite amount of material is required in this type of mold.

The semi-positive type of mold is generally used in compression molding and the flash type generally used for the injection type.

The next step to consider is where to part the mold.

Can holes be cored or must they be drilled?

How to locate inserts if there are any?

Where to place the knockout pins and push back pins?

How to heat the mold? Molds may be heated with steam, electricity, or hot water under pressure. Steam is generally used.

How to fasten the mold in the press?

(Continued on page 38)

Molding Processes for Resinous Plastics

(*A Discussion*)

By W. B. ROSS
DIEMOLDING CORPORATION
CANASTOTA, NEW YORK

FIRST of all, let us analyze this subject. We are all familiar with the word "molding" (as applied to mud pies, wax candles, etc.) but—when we attach the term "Resinous Plastics," we appear to make it complicated. So let us define the word "plastics." The common use of this word means—capable of being molded or modelled.

Now, the other word in this subject is "resinous" which qualifies or describes rather broadly the type of plastic. Resin is a synthetic, organic substance which can be formed or molded into almost any shape—by the application of heat and pressure. Now to discuss the molding of these Resinous Plastics.

Two Groups of Plastic Materials

First, it is necessary to divide these plastics into two groups. The outstanding characteristic of one group requires chilling or cooling of the material in order that it will set or harden. This type of plastic can, by the repeated application of heat and the subsequent cooling, be remolded into different shapes almost an indefinite number of times. This type of material is called a "Thermo Plastic," or in other words, a material which becomes plastic by the application of heat. Some of the materials which come under this heading are: Shellac, Cellulose Acetate, Ethyl Cellulose, Methyl-Methacrylate. A discussion of this material is covered by F. W. McIntyre in his paper on Injection Molding of Cellulose Plastics in this issue.

Now, the second type of plastic material is the one which becomes soft under the application of heat and pressure, and under the continued application of this same heat and pressure, becomes hard and set. This setting, or hardening, is accomplished by a chemical reaction of the resin which renders the part incapable of remolding. This type of plastic is called "Thermo Setting." You will recall the first type was called "Thermo Plastic." The best-known and most widely used materials in this second group are: Pheno-Formaldehyde, Pheno-Furforal, Urea-Formaldehyde.

Most of the widely-used plastics come under one of these two groups, and the molding technique is entirely different. It has been my assignment to discuss the molding of this last type of plastics—the "Thermo Setting" Resinous type.

Our modern plastic industry is comparatively young. It only dates back to the year 1907 when Doctor Baekeland discovered a synthetic resinoid. It was two years later, in 1909, when the first "Thermo Setting" Phenolic Molding Material was introduced to the market. The first type of plastics was of the wood filler variety and, because of its high electrical insulating qualities, it was first introduced into the electrical market. After the acceptance of this new resinous material, it was necessary to find a way of molding it. So the material found its way into the shops of the rubber industry—particularly the hard rubber industry where existing molds were in operation. In these earlier days, the time for polymerization (or "cure," as it is more commonly termed) required ten, twenty and thirty minutes. Today—from fifteen seconds to about five minutes is required — depending somewhat upon the size and the design of the piece, and also the type of material used.

Plastic "Mass Production"

Today the molding of plastic materials compares favorably with the more highly organized methods of mass production in our present-day industries. This advancement, of course, is due entirely to the combined efforts of the material manufacturers and Tool Engineers who have worked together in the interests of this development. In the early days, knowledge of what actually happened on the inside of a mold while the parts were curing was very limited. It was known that a chemical reaction occurred—but the result of this chemical reaction was not important, as long as the part eventually cured or set. Today, with the extensive use of plastics, very definite and exacting requirements are encountered. For instance, in the molding of photographic camera parts, a very definite requisite is that the molded part must not fog the highly sensitized film. Of course, this is a raw material requirement—and care must be taken in the molding procedure to see that the proper process is followed.

Different Fillers

Before we go into the molding procedure, let us consider the different types of fillers, which are used in resinous plastics. The most commonly used, and incidentally the cheapest, is the wood flour type. This material is satisfactory for the average application, where temperatures will not exceed 280° Fahrenheit and where acids and alkalis are not encountered—also where exceptional strength is not required. Next, we have the resinous plastic which has a filler with a high percentage of asbestos. This is for applications with a higher heat requirement—but not to exceed 450° Fahrenheit. Then we have the mica fillers for higher dielectric strength; the cotton flocks, paper fillers, for use in considerably higher impact strength requirement. Then we have the fabric base filler. Some of the fabric base fillers have an impact strength comparable to cast iron. The last one we will refer to at this time is a material with a very high resin content. This material is recommended for resistance to moisture and alkalis.

You will note that all of these different types of material vary in their physical characteristics and likewise they vary somewhat in their molding procedure.

Compression Molding

Now let's go back to the early days in a hard rubber plant and mold some parts from the wood filler material. The equipment comprised small hydraulic presses and the molds were hand-operated. In other words, the open mold was filled with an accurately weighed charge—then the force or punch was placed in position and the assembly placed in a press. The pressure was applied and, after a cure of ten to thirty minutes, the mold was removed from the press and opened on a bench. Heat was obtained from the heated platens which were fastened to the press. Originally, these molds were single-cavity molds but later they were expanded into multiple-cavity molds but still had to be operated by hand. Then later, as the industry grew, and by the co-operation and help of machine builders, semi-automatic presses were designed and built. With this new semi-automatic press, molds did not have to be handled. Consequently, they could be larger and today a mold of 100 or even 200 cavities is not uncommon. With these large cavity molds, the problem of accurately weighing the material was solved by the use of pharmacal pilling machines. Later, these pilling machines were redesigned to meet our present-day demands.

This hand-press type of molding is still being used where intricately shaped parts require the use of molds which are made up of loose or assembled pieces, and where these loose pieces are ejected with the molded part. These loose pieces are then separated from the casting and reassembled back in the mold and ready for the next cycle. This type of molding, of course, is costly and does not lend itself to high production requirements.

With the use of these pilling or preforming machines, the molding and handling of most of the resinous materials has been simplified considerably. It reduces the bulk factor of the material from 2½ to 1½ to 1. It facilitates ease of handling so that large multiple cavity molds can be loaded quickly and accurately. The fact that the bulk factor of a raw material can be reduced also helps in mold construction, as a smaller loading space is required to handle the volume of material. Preforms or pills also allow for a more uniform pre-heating of the molding compound, before it is placed into the mold.

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Injection Molding of Cellulose Plastics

(*A Discussion*)

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THE subject for discussion, "Injection Molding of Cellulose Plastics," covers an entire plastic molding process that is yet new and it will be best first of all to review the progress made up to date in this field by the producers of the plastic material, the builders of injection molding machines, and the mold makers.

Approximately five years ago the injection molding process began to receive consideration in this country from makers of plastic novelties for chain store consumption. Before that time small installations had been made in this country but the novelty manufacturers were the first large scale users of plastics to become interested. It offered them a means for producing their articles cheaper than was possible with cellulose nitrate, popularly known as celluloid, which they had been using.

One reason for cheaper production, was the higher speed of injection molding as compared with the fabrication required with nitrate. This nitrate was available only in sheets and rods and had to be machined and formed. Although it was high priced, the scrap or trimmings were of little value and had to be kept carefully to a minimum.

The cellulose acetate used in injection molding was available in granular form, allowing it to be used in hopper fed automatic molding machines. Because the scrap, such as sprues and runners, could be reduced to granular form, and used again, the waste to be considered was negligible as compared with nitrate. The cost per pound of acetate was, even then, much lower than nitrate, adding another inducement for the changeover.

Of great importance was the low inflammability of acetate. The highly inflammable nature of nitrate plastic made it dangerous to expose articles made of it to high heat, as you may recall in instances when combs have ignited in ladies' hair and men's collars have suddenly gone up in smoke, when a lighted match came too close. Freedom from lawsuits caused by these accidents was the last argument needed by the novelty manufacturers to tackle this new process and start tooling for it.

In the meanwhile custom molders, doing job molding with materials such as Bakelite, started receiving inquiries from their customers for articles made of injection molded material. The process spread more and more until the general public was beginning to use the word "Plastics," because of the large production of popular low priced articles by injection molding. Today many major industries including Automobile, Radio and Refrigerator manufacturers use injection molded parts for both decorative and utility purposes on their products. Some mold these parts on their own machines while others use the facilities of the large custom molding plants now in existence and doing injection molding only.

Cellulose Acetate

Cellulose acetate was the first material to be used in quantity in injection molding. It was produced from the same raw materials as the synthetic yarns, such as rayon, so widely used today and consequently had the sponsorship of large and progressive companies. However, it was a source of concern for some time to the molders, because its lack of uniformity coupled with their lack of experience in handling it, made slow going for them and caused discouragement in many quarters. Variations in granular size, different amounts of shrinkage from one lot of material to the next, even widely different results when using two different colors of the same formula, one after the other, in the same mold, all added to the general confusion. However, the problem lay with the chemists who developed the material and they gradually tightened up the wide tolerances originally left until it is now rare to hear any of these old complaints about acetate.

As the applications of injection molded parts increased, demand arose for materials having physical characteristics different from acetate. The chemists had to work with synthetic compounds already used in other forms and with new compounds not yet out of the laboratory stage.

They worked first with the polystyrene compound which was already available in fabricated forms and which was used for electrical parts because it was a good dielectric, a property not true of acetate. This material had been injection molded abroad for some time but was very difficult to handle because of the high operating temperatures required and the tendency it had to change from a solid to a very liquid form with only a small in-between range of medium viscosity necessary for economical injection molding. The high temperature, which was much more than necessary for acetate, was not objectionable in itself but the fact that a molded polystyrene part would begin to lose shape at the same temperature as acetate made this high heat impractical. If the molded polystyrene had become unstable only at a proportionately higher heat, the molding temperature would not have been considered as the molders would then have had available the characteristic of stability of molded parts at higher temperatures, which they were seeking.

Constant experimenting was carried on with polystyrene and it was soon being used for articles such as fuse bodies, cores for resistor coils and switch blocks. Although available in all colors, polystyrene in its natural state was clear and transparent. Because of its extremely low moisture absorption, because it imparted no taste or odor to any liquid in contact with it, and because it was resistant to many acids, it was possible to injection mold successfully, containers, bottle caps, fountain pen barrels, and parts inside refrigerators, to name a few items. This could not be done with acetate because of its lack of the above properties. More than that, where parts made of glass caused serious failure from breakage, polystyrene, where it could be substituted, was used to stop this trouble entirely. Along with the other injection molding materials, it had a tensile strength of about 7,000 pounds per square inch, good durability and elasticity, and as the molded parts required no careful handling to prevent breakage, it became classified as "unbreakable glass," although having no chemical connection with real glass.

Another Material

Another material to be developed was the acrylic compound, which was also available in fabricated forms but had just begun to be considered for injection molding. This compound was clear, and highly transparent in its natural state to the extent that it was optically better than all but the best crown glasses. Unlike polystyrene, which it resembled so closely in its physical characteristics except for this superior optical quality, it began to be used by the molders mainly in its clear state, although it was also available in all colors. This continued as the possibilities became more recognized and soon there was a large demand for reflectors, lenses, good quality hair brush handles and many other articles made from this remarkably clear material. In one case it would maintain the clarity of glass while reducing the cost of manufacture and in the other it would add to the appearance in a manner never before possible.

This acrylic material, along with polystyrene and acetate, required constant experimenting and improvement so as to be practical for the injection molding field and was the last of the three to reach this state. It required careful control while being molded in its clear form so as to be free from internal strains and visible defects in parts which must be optically correct or free from blemishes to be of value. However, the extra attention was repaid by producing articles never before obtainable for the same cost.

Other materials have been produced to compete with those already mentioned. They have some of the properties of all the other compounds and in

some cases have characteristics perculiarly their own. They are the results of different approaches to the same objectives and in some cases have proved themselves quite worthy of consideration. Two of the best are acetal butyrate and vinylacetate, the latter being widely used in another form as the transparent binder in safety glass.

All of these materials are in their present state of perfection and have become lower and lower in price because of constant effort by the chemists and the manufacturers of the plastic compounds, but as the scope of injection molding widens, the work yet necessary for them becomes more apparent. There are some shortcomings at present, and these will be discussed briefly later.

Injection Molding Machines

The initial development of injection molding machines was rapid because it involved only the adaptation of presses already in use for other processes, particularly die-casting. The production demand from these machines was low and the molded articles were simple enough so that molders had few demands for improvements. As the number of machines increased and more was being expected of them, their weaknesses became serious and the first actual changes were made to suit the new demands. One of these was to lift the machines out of the class of light weight presses, well suited for their original purposes and, using the same principle, make them strong enough to give trouble-free service in continuous operation while exerting on the molds locking pressures far in excess of any requirements for the same size molds in other processes. Freedom from flash was absolutely necessary for economical molding and the gradual increase in size of injection molds and the high pressures necessary on the plastic materials, sometimes reaching 30,000 pounds per square inch, made the heavier machines necessary.

Another important development was the so-called heart of the injection machines, the heating chamber, in which the molding material was heated to the point where it was plastic enough to flow under pressure into the molds. This chamber held several charges of material which moved from the cold to the hot end as the injection plunger made each stroke and added a new charge. It was necessary to heat this material so that it was at just the proper temperature when it left the hot end and was forced into the mold. The time required to reach this temperature necessarily had to be varied to suit the time cycle of each individual mold. Most molds required this temperature to be within five degrees of an established "setting" at all times for successful operation. It can be seen therefore, that a problem in temperature control had to be solved in order to make a heating chamber universal enough to suit any condition which may come up.

Because the material was quite viscous at molding temperature but would flash, burn, and lose its strength if overheated even a few degrees, high pressure was necessary to force it into the mold impressions fast enough to insure complete filling and freedom from shrinkage before it chilled. The chamber had to withstand this pressure without bursting, necessitating a very heavy wall thickness. The poor heat conductivity of the material made it necessary to pass it through the chamber in a thin section in order that it could be thoroughly heated in the proper time without requiring a chamber of excessive strength. Much machining and polishing was necessary to achieve this thin section while even the slightest pocket, where material might lodge, had to be eliminated to prevent burning. The problems raised by these conditions have been approached from different angles and have been partially solved. The heating chamber is subject to more improvements however, which will be discussed later.

The process required automatic control of the molding cycle, and timing units suitable for other purposes, had to be improved to operate successfully under the conditions demanded of them. As more and more machines were put into operation new weaknesses were exposed but were taken care of more or less readily, depending on the individual manufacturer.

With approximately 600 machines in operation in this country today, the building of injection molding machines has settled down to a steady program. The developments, except for the heating chamber, were readily completed as they involved changes in design to take care of recognized conditions and required little experimenting.

Molds for the Injection Process

The making of molds for the injection process in the beginning followed the same general procedure as the machines, in that they were adapted for this work from other molding processes already being used. Following regular foundry practice, they were built with sprues, runners and gates. In many cases impression blocks from a compression or a forming mold were merely pressed into light holding blocks, gates and runners were cut, a sprue forming bushing made up to connect with the heating chamber nozzle and the mold was put into production.

It was soon found that more substantial construction was needed. When molds were made too thin, they would simply bend enough in the center where the plastic material entered, to cause constant flashing. It was not economical to remove this flash from the molded article so the thickness of the molds had to be increased to stop this condition. Of course on a light machine even a heavy mold would flash but since it was also found that a light mold would give trouble on a machine with higher locking pressure, all thought of keeping mold costs down by saving on steel had to be abandoned. It was also found that because of flashing, the soft steel around the impressions would become indented from the high pressure of the incoming plastic material. As mentioned before only a few degrees of heat higher than required would make any material flash on the heaviest machine, a condition which would occur particularly when starting a machine in operation before the heat was properly regulated. To prevent damage to the mold it became standard practice to harden all impression blocks on production molds.

Many articles were found to be more easily molded if they were gated so that they were connected directly with the sprue. Means had to be devised to allow more than one impression of this kind in a mold especially when small parts were involved. The first made use of a so-called multiple nozzle on the front of the heating chamber so that the flow of plastic material could be diverted in as many different passages as there were impressions. These passages connected with the sprues to the various impressions which amounted to several individual molds in the same holder. As many as twelve pieces in a mold were run successfully this way, although close control of the heat in the multiple nozzle was necessary.

Another method allowed the use of the standard single nozzle heating chamber, the diversion of plastic material being accomplished in the mold, which was made in three sections. A main sprue and runners formed in one part of the mold fed the individual sprues to each impression in the center section. In order that the molded part could be pulled out by the ejector half of the mold, shearing knives operated by the opening motion, cut the small sprues from the runners.

Molding Internal Threads

The molding of parts with internal threads was accomplished first by using cores which were ejected with the molded parts, unscrewed by hand and replaced in the mold by the operator. Two or three sets of cores had to be on hand in order to make fast production possible.

Later, an automatic device was perfected, whereby these cores were built into the mold and rotated by an electric motor connected to them with a chain. The motor was controlled by the same timing devices used to operate the machine. This allowed the parts to be made at the same high production possible for them without threads and did not require the operator to place his hands between the open molds.

One of the features of injection molding was the high surface gloss on parts as soon as they came from the mold. This finish was due in part to the material itself and partly to the polish on the impression surface. The material has a natural tendency to form a glossy skin in the mold and a highly polished surface improved this gloss. However, the polished steel would become dull

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PUNCHES AND DIES

Symposium on the subject as given before a technical session March 8th, 1940 in New York City, National Meeting A.S.T.E.

Punches and Dies for Small Products

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PUNCHES and die operations are particularly suited to the manufacture of small parts due to physical size of part, operating economy, flexibility of operations, short manufacturing interval, and the comparative ease with which the required degree of accuracy can be maintained.

It is difficult to define the word "small" in connection with punches and dies. A part classed as small in one plant might be considered large in another. For the present purpose we will consider parts used in typewriters, cash registers, adding and accounting machines, electric switches and relays and similar mechanisms to fall in this classification. The majority of parts in these mechanisms are made from light gages of stock; a factor which is of considerable importance when considering operations with punches and dies.

Planning Essential to Economy

The manufacturing economy which it is possible to achieve with punches and dies is well known, but deserving of mention at this time. Economy is too often taken for granted as occurring automatically with punch and die use. As a result we sometimes fail to achieve it.

Careful planning is necessary to accomplish correct results. The two most important factors which must be considered are, design of part and total quantity of parts to be produced.

The original design of the part may not be suitable for punch press production. Improper part design may cause unnecessary die expense either in building, or in maintenance. It may result in unnecessary secondary operations. Tolerances specified may be closer than the use of the part requires and may greatly reduce operating efficiency. Material specified may be difficult to work and hard on dies and may not be required by part usage. It is essential that the function of the part be thoroughly understood before ordering tools or establishing manufacturing methods.

Quantity is an important factor in selecting tools. There are usually several methods of producing the same part using punches and dies. We should select the method which will result in the lowest ultimate part cost. Ultimate cost is the cost of producing a given quantity of pieces plus the cost of the necessary tool or tools. It is essential to know the total quantity of parts which is expected to be produced in order to use ultimate cost correctly. Proper use of ultimate cost will prevent under-tooling or over-tooling. Either condition can prevent economy in part cost.

The time to consider both factors (part design and quantity) is when planning for production. It is impossible to correct tooling or manufacturing procedure after production has actually started, without wasting money, due to cost of revising tools and methods.

Flexibility

The flexibility of punches and dies is apparent in the variety of operations which can be performed. It is also apparent in the wide variety of materials which can be worked. In this respect punches and dies have far greater flexibility than other low cost production methods such as die casting and moulding.

Accuracy

Punches and dies are noted for the uniform quality of their product. This is a direct result of the working principle involved. The material to be worked is cut, formed, drawn, or coined in a single stroke, using sufficient pressure to shear it or work it plastically.

This principle permits the use of tools in which the relation between the working members may be fixed for their entire life. A single movement, or at the most, a few movements are all that is required to bring the working members into use. These movements are readily guided and controlled.

The same principle permits working edges and areas of tools to be equal to the contours or areas being worked. The advantage of this principle is readily apparent in comparing the work required to produce a given outline by punch and die methods with any other method. The punch and die displaces the material in a single stroke. Other methods are based on passing the work by a tool or vice versa, while the excess stock is removed piecemeal. This feature contributes largely to the high quality life of the tools. The duration of contact between the cutting edges of the tool and material is low and the length of working edge equals the contour being worked. Short duration of contact, and large amount of working edge result in very low tool wear and long tool life, measured in terms of pieces produced.

The principle of working metal by pressure also permits a higher concentration of tools in the same physical area than any other process. This is effective in cutting down the number of operations required to produce any given part.

All of these factors; fixed relation of working members, simple tool movements, low duration of contact and resulting high tool life, and heavy concentration of tools, all contribute to the uniform quality of work produced.

Limitation of Punches and Dies

The principal limitation to the use of punches and dies is quantity due to cost of tooling. Rapid strides have been made in the last few years in reducing the manufacturing quantity at which punch and die operations become economical. This has been achieved partly by refinement in the design of parts due to a better knowledge of punch and die operations on the part of the product engineer, but to larger extent by a radical change in punch and die construction to meet low quantity manufacturing. It has also been brought about partially by a change in the manufacturing methods used to build dies. I refer principally to the use of standard members in punch and die construction, which have been processed in quantities, such as stripper plates, stock guides, trigger stops, and die blocks.

Types of Punches and Dies Used in Producing Small Parts

The whole range of punch and die operations are used in producing small parts. Many small parts are processed from raw material to finished piece by punches and dies.

The use of punches and dies to finish working surfaces is probably one of the most effective means of using these tools. I refer to the use of dies for shaving operation. The operating speed and uniform quality obtained are particularly striking in comparison with competitive means.

Both high and low production dies are effective in producing small parts. Small size is a distinct advantage when combining several operations on a high production die. It is equally advantageous in constructing and using low production dies.

Low Production Dies

The low production dies used at the Endicott plant of the IBM Corporation are made in two basic types. The first type consists of a loose punch and die, commonly referred to as a Continental or "put and take" die. The second type consists of a punch and die made to fit a standard die set. The Continental or "put and take" die is generally familiar to all companies who have to handle press work in small lot quantities. In operation it is necessary to use this type of die between flattening dies.

The construction used at Endicott follows general construction practice in use in most plants. The punch guide plate and stock guides are riveted to the die. The punch guide plate takes the place of the stripper. Tool steel is used for the punch and die members instead of cold rolled steel as this material proved unsatisfactory. The die thickness ranges from $\frac{3}{16}$ to $\frac{3}{8}$".

The effectiveness of this type of die can be lost entirely by using it for a high quality job. Building continental dies to quality limits rapidly increases tool cost. Where quality is a factor, it usually is best to obtain it by secondary operations and by other means, than punches and dies. This method is usually cheaper than adding to the expense of producing and maintaining the low production die to quality limits.

The principal advantage of this type of die construction is its extremely low cost, which makes it possible to apply punch and die economy to very small manufacturing quantities that otherwise could not be handled by this method. At Endicott it has been used for blanking, piercing and forming operations. Low production dies also have decided value in experimental work and in reducing the manufacturing time on rush orders.

The limitations of this type of die are as follows:

1. Slow operation.
2. Low economic life.
3. Limited range of operations.

Slow operation is due directly to simple construction and the use of loose punch and die members. Due to these limitations, we always build the Continental die as a single station, never as a progressive die.

Low economic life is due directly to its slow operation, resulting in high operating cost. We find that this type of die, as applied to our requirements, has an average economic limit of about 5,000 pieces. In this connection we should like to point out that establishing a proper economic limit is of considerable importance. Many of the Continental dies have a working life far in excess of 5,000 pieces. It should be borne in mind, however, that when a punch press is being used with this type of die, it is producing only on an average of 1/6 of its capacity with a permanent tool. An unnecessary use or an attempt to extend the use of these dies to higher production quantities will have a serious effect on the efficiency of a punch press department. Extension of use will also result in a higher ultimate parts cost. No fixed figure can be given for the economic limit to be used by all manufacturing companies, or for that matter, for all parts run by the same company. This economic limit will vary with the size and type of part and the conditions under which orders are run. It will also vary by type of operation.

Limited range of operations is due to simple construction and lack of positive control over punch and die alignment. This eliminates its use for shaving operations and restricts it to single station construction as previously stated.

The second type of low production die in use at Endicott is made to fit a standard holder or die set. The operation of the die is exactly like high production dies due to the use of the die set. The advantages of this die are low construction cost and high operating efficiency. The cost range lies between that of the loose punch and die and the high production die.

It is used for blanking, piercing and forming operations and is made both as single station and progressive dies. It is made in light sections (die blocks ½" thick).

The limitations of this construction are:

1. Short life (measured in number of pieces).

2. Limited range of operations.

Short life is due to light section. Limited range of operations is due to the use of common holders which limit the size and shape of work handled. It is also impractical to use this type of construction for shaving dies due to lack of positive control over punch and die alignment. To make the operation of this type of die effective, it should be made in several standard sizes which are selected to meet the needs of a particular plant. Our experience with this type of die extends over a period of three years, and has been satisfactory enough so that at the present time we are planning to extend its use.

The Use of Standard Tools for Low Quantity Production

The use of standard tools, such as V type forming dies, adjustable piercing and notching dies, should receive serious consideration for small lot quantities. Nearly every shop producing parts by punch and die methods finds it advantageous to have tools of this type available. The cost of tooling, when using standard dies is very slight. Usually the only expense involved covers simple locating devices, such as pins, nests, or templates. The use of these tools often involves a higher set-up cost than some of the low production or temporary dies. After set-up is completed their operating efficiency compares favorably with any of the low production tools and in many cases is high enough to compare well with high production tools.

High Production Dies

In considering the application of high production dies we may classify them as follows:

1. Dies for primary operations
   (a) single operation
   (b) Compound dies
   (c) progressive dies
2. Dies for secondary operations
   (a) Single station
   (b) Compound
   (c) Index dies

Single Operation Dies—Primary Operations

In performing primary operations, single operation dies should be restricted to simple blanks or to pieces where part design (size and complexity) eliminates the possibility of more than the blanking operation being done from the strip. Its use under any other circumstance results in unnecessary handling and operating expense and is not economical. The single operation die has a relatively small field of use.

Compound Dies — Primary Operations

Compound dies for primary operations have their greatest use on very thin materials or on parts where a high degree of accuracy is required between openings and the contour of the blank. The advantage of compound construction lies in having all work done in a single position with the material held under pressure. This eliminates the use of pilots; a feature which is desirable in processing thin material or where very close accuracy between contour and opening is essential.

Compound construction is also advantageous where the outside contour of the blank must be held to a very close size, but where surface finish is not important. This is sometimes necessary due to using the contour for location on subsequent operations. Ejecting the blank by a spring or positive knockout makes die draft unnecessary, insuring constant size of blank throughout the life of the die.

Compound construction is of advantage occasionally when the size of the part (area) taxes or approaches the physical size of press. Under such a condition this construction enables two operations to be performed in a die whose surface area is the same size as the part.

The limitations of compound construction are slow operation and high tool cost. Slow operation is due to the delivery of the blank back through the stock and the necessity of waiting for the upper member to rise before complete ejection of the blank is possible. This reduces the speed with which the material can be fed. Compound die construction involves more die parts or details than a progressive die and therefore, costs more to build. It is also more expensive to maintain in operation. Design of compound dies should be based on having the Blank die member on the upper shoe to permit use of positive knockout in press ram and insure easy disposal of pierced slugs. The only exception to this should occur in dies where drawing is one of the operations performed and when the dies are double acting.

Viewing the entire field of primary operations the number of parts which require the use of compound dies is relatively few and its field of use small.

Progressive Die

The progressive type of die is the most flexible and economical type for primary operations. Flexibility is clearly indicated by the number and variety of operations which can be performed in one handling of the material. We have progressive dies in operation at Endicott which handle the following combinations of operations:

1. Pierce, swage, trim, form and blank out.

2. Pierce, first and second form, — blank out.

3. Pierce, first and second shave, — blank out.

Physical size of part is an important factor in determining the application of progressive dies. Small part area makes it possible to perform a larger number of operations without requiring very large punches and dies or large press equipment.

The principal limitations imposed upon the use of progressive dies are those imposed by the design of the part itself. Parts made from thin materials, particularly materials under .020 in thickness, may offer a difficult or an impossible limitation on the use of a progressive die. This is due to the difficulty of controlling thin material accurately with pilots. Part design may also offer complications for the following reasons:

1. Complex forming or forming heavy gage stock.
2. Shaving operations involving most or all of the outside contour.
3. Swaging operations usually must be restricted to small areas.

I would like to emphasize the importance of quantity as a factor in selecting type of die to use.

It is the principal factor in deciding whether or not to use progressive dies. It increases in importance as the number of operations increase.

The necessity for handling blanks as individual pieces through a secondary operation rapidly builds up part cost. The operating speed of the average secondary die is seldom greater than one-half that of a progressive die which will handle all the operations involved. A careful cost analysis based on ultimate parts cost will frequently indicate the use of the progressive die at quantities much lower than might normally be anticipated. We are now building progressive dies with die blocks ½" thick in order to take advantage of their efficiency at lower total parts quantities. The word, total, is used here to indicate total production anticipated at the time tooling is being planned.

Design Problems in Progressive Dies

The major design problem in building a progressive die is to provide means for adequately controlling the material in its passage through the die. From a designing standpoint this offers two basic problems:

1. To provide an adequate number of pilots properly spaced.
2. To provide a means for overcoming or compensating for dimensional changes due to hardening of the die block, or to compensate for growth of material.

The use of pilots requires very careful study. The size of the pilots selected should depend more on the total weight of the strip which is to be handled than on the thickness of the strip. All too frequently pilots selected on the basis of strip thickness prove completely inadequate. When the use of large size pilots tends to complicate die construction or to cause unnecessary waste of stock, a smaller size pilot may be substituted provided it is supported by bushings in the stripper.

The position of the pilot holes should be such as to give adequate control of the material. If holes of the proper size and location exist in the blank itself, these of course should be used. If, however, these holes are too small or are located too close together, or in such a position as to permit considerable shift of the blank, the designer should resort to placing the pilots in the scrap.

The number of pilot positions in a complex die involving three or more stations is often difficult to determine at time of design. For this reason it is good practice in design to provide clearance in the die block for pilots in every die station. It is never necessary to use all of these pilot positions, but the cost of providing for their possible use is very slight. The best position for the pilots can then be determined by an actual tryout of the die.

When very accurate control of the stock is essential, such as in shaving operations, it is advisable to use the spring type of stripper. This can readily be accomplished by providing stock guides mounted rigidly on the die which extend a slight distance over the edge of the stock. The spring stripper then has free access to the larger portion of the stock. In addition to leveling off the material, it also assists the pilots in providing rigid support for the strip. The pilots must of course enter and position the strip before the stripper touches it. The use of this type of stripper also makes it easier to clean the die; a feature of particular advantage where shaving operations are involved. This construction is also of value where forming operations are carried out, and in cases where more than one form is involved, frequently becomes essential. In some cases it is advisable to have a solid stripper over some sections of the die and a spring stripper over others.

Means for overcoming or compensating for dimensional changes due to hardening of the die block can be accomplished as follows. The number of stations required should be the subject of careful study and kept to the lowest possible minimum, without sacrificing good die design or tending to increase the cost of maintenance. Where a large number of stations cannot be avoided, and the part area involved is large, it is advisable to use two or more separate die blocks. Each one of these blocks may represent a single die station or several stations. When each of the die stations occupy an area as great as 3 x 4 it is usually advisable to make each station a separate section or block. A slight amount of clearance should be provided between each block. This feature makes it possible to compensate both for changes due to heat treatment and for stretch in the punched material during the process of actual operations.

Swaging operations in combination with piercing and blanking, add to the problem of supporting both the material and the cutting punches. The problem is solved partly by piloting and partly by trimming and timing. Openings are pierced each side the section to be swaged to permit free flow of material and often trimmed afterwards to size. The trimming operation is used where the contour must be held to close limits as it is impractical to confine the material during swaging. Confining material would add to the power required, complicate the problem of feeding, and make die construction complex. Swaging operations in progressive dies are limited to relatively small areas.

Among other problems encountered in the design of progressive dies are the following:

1. When to use bushings, sections and inserts in cutting stations.
2. The maintenance of forming and swaging sections.
3. Disposal of chips in shaving dies.

Bushings should be used in the cutting sections of a die when it is necessary to maintain the size, straightness and location of the opening in the part to close tolerances. The increase in die opening due to sharpening can then be compensated for simply by replacing a bushing. In the same way hole size and straightness can be controlled during the life of the die.

Bushings can be used to overcome the effect of heat treatment on hole location by permitting the use of soft sections with hardened bushings. When it is necessary to use hard sections, bushings will often make it possible to compensate for the effect of heat treatment by making the die opening large enough to grind.

Sections and inserts should be used for the following reasons: to reduce die cost, improve die construction, eliminate hardening problems or make it possible to grind the die opening. The use of sections and inserts should always receive careful consideration, and their use avoided, unless they accomplish one of the purposes noted above.

In designing progressive dies with forming on swaging sections provision should be made to maintain the proper relation of these sections with the cutting sections. Unless this is done the maintenance cost of the die may be excessive. The simplest ways to maintain relation of sections is by providing either a wedge or shim adjustment under the swaging or forming sections. The height of these sections can then be easily adjusted to conform to the cutting sections as the cutting sections are ground.

Shaving operations in progressive dies present a major problem in disposing of chips. The problem is sometimes solved by the shape of the opening in the stock. More often it is necessary to use air as a means of disposal. The air may be applied through the die opening using small copper tubing or it may be applied through small holes provided in the punch. The latter is usually the most successful. In both cases an air valve is set to trip at the bottom of the stroke, forcing the chip down into the die opening as soon as it is cut.

Maintenance Cost—Progressive Dies

The cost of maintaining progressive dies rises in proportion to the complexity of the tool. The highest maintenance

(Continued on page 46)

Punches and Dies for Large Products

By GORDON L. REED
CHIEF ENGINEER
YORK CORRUGATING COMPANY
YORK, PENNA.

WHEN the subject of punches and dies for large products was assigned me, there arose in my mind a question as to what portion of the subject might be of most interest since the subject itself covers a big field of work.

Much literature is written covering the field of cutting tools including blanking, piercing, and trimming dies. Likewise forming dies for smaller parts, and drawing dies for shells and pans are well covered in the many technical books which are on the market.

From these books we may obtain formulas for die clearances, die drafts, determination of blank sizes, calculations for draw and redraw operations, pressures required, and various other data necessary to the designer and die maker. These formulas have been tried and proven, and are the elements on which modern die making and die designing are founded.

A few years ago the design of most dies, for large products, was comparatively simple. The demand for higher production and design changes brought about larger stampings including all steel auto bodies, one piece fenders, one piece side panels, turret tops, etc. As the body designer met public demand with these products, the die designer had to design tools to produce them and the simple trimming and piercing die was soon converted into a wedge or cam action trimming or combination trimming and piercing die with interlocking steels, positive action return on cams, return of cams by the use of cable and pulleys whereby the up-stroke of the ram would pull the slide back, and many other combinations whereby these large stampings might be completed in a reduced number of operations and at the same time produce stampings better and cheaper than before.

New Trends in Die Makers Supplies

With this advance in design and increase in size of tools, die makers supplies were developed which would assist in building these tools cheaper and quicker.

Among these supplies were such products as Universal punches and dies. The use of these punches enables us to obtain greater production between grinds, reduces lost press time by enabling the die maker to make replacements without removing the die from the press and frequently without removing the stripper, and reduces die maintenance cost.

The development of composite steel, with its soft base helped reduce die costs by eliminating the milling or planing operation formerly necessary to make a seat and backing for the cutting steel. The steel can now be mounted on a flat plate.

For use in the field of forming dies there was developed a metal of low melting temperature which expands upon cooling. It is used in cutting and piercing dies for anchoring punches, bushings, and cutting steel and we find places where its application as a cast pressure pad enables us to reduce our die costs considerably.

My experience with the use of this material in forming dies has been that since it reduces the cost of the original building of the tool it is desirable for low production, but frequent repair or replacement makes the advisability of its use very questionable where high production is required.

Quick acting toggle clamps were designed and came into popular use since they enabled the operator to quickly and more positively lock larger stampings in their proper position for gauging in the die.

The use of these products has reduced the original cost of the building of dies, has reduced maintenance; and in some cases there is a salvage value after the tool becomes obsolete which in the low production or jobbing shop is desirable.

The die designer is accomplishing his purpose in that he is designing tools which permit the production of larger stampings, more cheaply. But these newly designed dies are still based on the fundamentals spoken of in the beginning of this paper and found in technical books. These large, intricate dies are designed chiefly to combine operations, and by mechanical means, change the direction of application.

There is, however, one subject, pertinent to the building of dies for large products, about which very little has ever been written. This subject is the development of blank holders of draw dies for the drawing of irregular shapes such as auto body and auto chassis stampings including fenders, etc.

Complex Stampings

Cylindrical shells, pans, certain types of cab roofs, and many other similar stampings may be successfully drawn from flat blank holders, but such stampings as present day fenders require blank holders having a definite, irregular shape.

The development of this irregularly shaped blank holder is difficult to describe, but I will attempt to describe the method followed in our plant for development of a blank holder for a front fender. This procedure, over a period of years has proven itself to be economical and highly satisfactory.

After the fender has been designed, a full size wood model is made, this model being generally made to inside of metal dimensions, so that it may later be used for inspection of the stamping itself by fitting the stamping over the wood model after it comes from the die, thereby ascertaining if it is the proper shape and size.

The next step is to determine the approximate position which we believe, based on experience, would be correct to give the best drawing conditions. By this I mean the approximate "die line" position or the approximate angles from front to rear and from right to left in which to place the model for best results. After this approximation is made, the model is inverted and suspended from a frame over a surface plate and a square is used from the surface plate up to the various drawing points or peripheries of the model, and the final drawing position or "die line" of the stamping is determined.

The final position is found after all "undercuts" of forming or drawing edge have been removed. By this I mean that the drawing or forming edges must be 90 degrees to the base of the die with no point on the model or stamping undercutting the die wall between that drawing or forming edge and the base of the die. See figure 1.

After having the model set up in "die line" position, our next step is to determine the plan view or "box" shape of the lower die.

We have previously stated that the model was suspended over a surface plate. The model is now readjusted so that the high point of crown or the point on the model nearest the surface

Figure No. 1

Figure No. 2

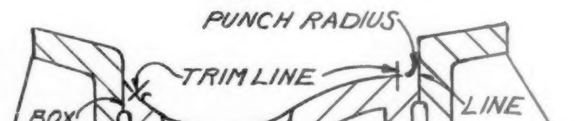


plate is just as far away from the surface plate as it is desired to make the thinnest point of the lower die. The practice in our plant is to make this thinnest point approximately six inches.

With the fender model thus suspended we determine the plan view or opening in the lower draw ring. Since we do not attempt to flange the fender in the drawing operation it is necessary to develop the trim edges of the fender on a theoretical surface of metal which is the actual surface of metal continued in space. See figure 2.

To this trim line we add about three quarters of an inch of metal plus the punch radius which is normally about one half inch. This will give you an idea of the calculations necessary to determine the plan view of the lower die.

It is now necessary to project this plan down to a flat layout which is done as follows:

(1) A cross section layout is made on heavy drawing paper or painted aluminum sheet, the squares of this layout usually being made one inch.

(2) This cross section layout is attached firmly to and flat on the surface plate directly under the suspended model.

(3) By means of projection blocks and surface gauge or a square, the points which we establish as the plan view of the lower die as described above, are projected down to the layout sheet.

(4) The points thus projected are now connected by means of body curves. If the projection thus made develops sharp corners, which experience has taught us, would tend to create undesirable drawing conditions, then this condition is modified and sweeps established by the addition of extra metal so as to create a condition which we would consider favorable for drawing. See figure 3.

At this point another layout on the cross section paper is made. We determine what we call the "crown line" of the fender. This is necessary as it is one of the principal developments used by the die designer in determining various heights necessary in the design of the die. The crown line is developed by measuring the distance from the surface plate to the points on the crown nearest the surface plate and recording these measurements on the layout sheet under the model. These measurements are taken every inch and plotted. The points thus plotted are connected by means of body curves which establishes the "crown line."

It has been described to you how the plan view was developed on a layout sheet. This plan view is now transferred to what we term a "base board" which is simply a board approximately one and a half inches thick having been made large enough to receive the layout. This layout on the base board is cut out and sanded to line. See figure 4.

Around this base board is attached "Beaver Board" which has been scored in order that it might be bent around the board and fit it very closely. Before attaching the beaver board to the base board, the beaver board is cut along the top edge to the approximate shape of the blank holder at the box line leaving it full for further development. This statement will be better understood later when we detail the method of developing the blankholder height at the box line. Also before attaching the beaver board to the base board the base board is placed on top of the layout which has been returned to its original position under the suspended model. These previous steps having been taken, now we nail the beaver board to the base board and tape it in position to keep it square to the surface plate.

It has previously been explained to you, when discussing the development of the plan or box shape, how points were determined which represented the box line, these points having been established on theoretical surfaces of metal which were the actual surfaces of metal of the fender continued in space. These points so established will now strike the beaver board at given positions. Measuring vertically one inch from this series of points we establish another series of points parallel to them and connecting these last mentioned points we establish a line which will now represent the blank holder line and give us a vertical draw around the fender of approximately one inch.

We again return to the process of transferring the blankholder line thus established to the layout sheet and this is done by measuring the height of the blankholder line on the inch lines shown on the layout sheet and thus plotting a curve on the layout sheet from which we may, when required, duplicate the blankholder line, established in beaver board, in wood. See figure 5.

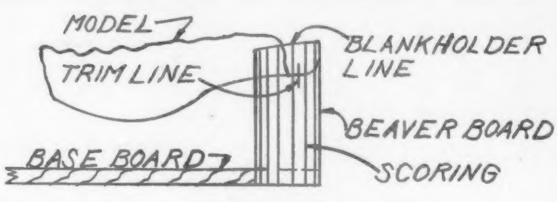


Figure No. 4

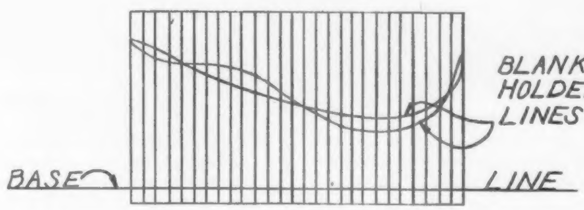


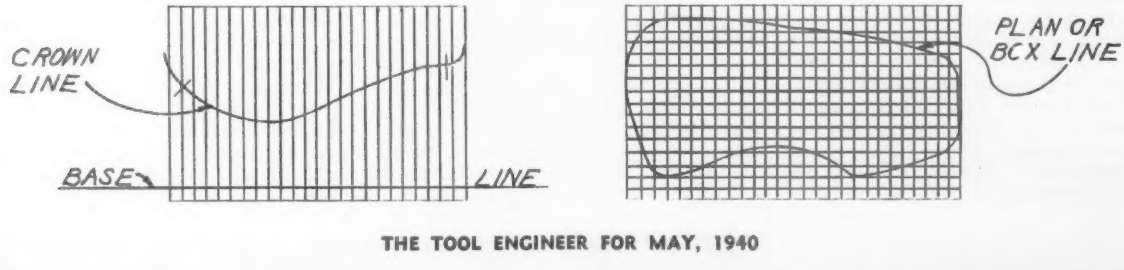
Figure No. 5.

All the lines necessary for the completion of the die design have now been obtained so our preliminary layout is dismantled and final working drawings are completed in the tool design department.

This completes the necessary preliminary engineering and drafting in connection with the main form die or draw die. The remaining development of the blankholder is done in the pattern shop during the construction of patterns from which castings will later be made.

We will not go into detail in the first steps of this pattern work. It will be sufficient to say that the pattern maker now duplicates in wood the box opening which in the original set up was made in beaver board. He uses as his starting point the base board previously developed and around this builds what

Figure 3.



is termed the "box" in wood which was formerly developed in beaver board.

The final step is now to be taken which is the final shaping of the face of the blankholder. See figure 6.

The face of the blankholder will be a series of angles. On the high side of the blankholder the angles will start at the box opening and extend upward away from the base of the die whereas on the low side of the blankholder the angle will start at the box opening and extend downward toward the base of the die. The simplest way of explaining the development of these faces is to say that a sheet of paper or very thin sheet of metal must touch all points of the box opening and fit without wrinkling, or must lay in a natural bent position, on the face of the blankholder.

The width of the blankholder face will be determined by the box opening and the final developed blank size. The entire blank must be gripped between upper and lower blankholders in order to keep the blank properly under control.

Since the development of blankholders has largely been a matter of experience, the foregoing description covers only preliminary points of development. There are other items such as the determination of the amount of stretch of metal and the proper shearing of the blankholder which must be checked in the pattern shop.

The foregoing description of the development of the draw die for large stampings is necessary in order to provide the absolutely necessary tooling to obtain the main drawn shape of any large stamping of this type.

The succeeding operations are determined largely by the economy of production.

In order to know the amount of this secondary tooling which is to be done it is first necessary to know the ultimate number of stampings which will be produced. For instance, let us consider the case of secondary tooling required for the production of pleasure car fenders as against the secondary tools which would be built for the production of fenders for a medium truck production as against the secondary tooling which would be built for a very low production truck.

In the case of high production such as is required for pleasure cars, cost of operation is paramount. Dies must be designed for a sequence of operations which will line up efficiently, performing these operations with a minimum of handling. It must be kept in mind that stampings cannot be stacked between operations, the design of tools must be such that there will be no slow operation which would hold up the line. Therefore, in this type of production, tools cost is a minor consideration and it is the duty and purpose of the die designer to contrive mechanical means incorporated in the dies which will permit the combining of operations, thereby reducing not only the number

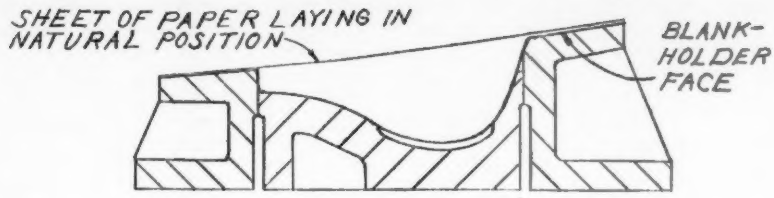


Figure No. 6.

of operations to a minimum, which naturally reduces the labor cost, but also at the same time keeping the number of presses required at a minimum by the operation of more than one die per press.

Secondary Tooling

Next let us consider the secondary tooling program considered advisable for the production of fenders for a truck with a medium amount of production.

The main thing is to determine the ultimate number of stampings which will be produced in order to determine a line up of operations which would place this fender in the class of so called medium production.

In order to determine this, the Tool Engineer must have a knowledge of the cost of building a set of tools for high production and the cost of a set of tools for this so called medium production. He must also know the production cost of this fender when produced with a set of high production tools and the production cost as produced by his tools as figured for medium production.

Based on his experience the Tool Engineer will form an opinion as to the proper operation line up. He should then prepare a complete estimate based on his proposed line-up and compare it with similar estimates based on more and less tooling. This will afford him an opportunity to make a final operation line-up based on the most economical procedure for the production required.

In a high production line-up it is assumed that all possible operations in the line-up are performed in dies.

In the medium production operation line-up all forming operations would be performed in dies and all piercing operations would be performed in small simple dies. This would eliminate blanking and trimming dies and these operations would be performed by scribing and flat shearing for the blank and scribing and rotary shearing to replace trimming operations.

Let us assume a hypothetical case in which the following figures would prevail:

1st	Cost of high production dies	$50,000
	Cost of medium production dies	$22,000
		$28,000
2nd	Production Cost—High Production, per stamping	$2.93
	Production Cost—Med. Production, per stamping	$3.53
	Difference, per stamping	$ .60

From these figures it will readily be ascertained that if the ultimate production were not to exceed 23,000 pair or 46,000 stampings the medium production operation line up should be used.

For a low production operation line up only the main form draw die is necessary. All other forming, shearing and punching operations should be performed with hammer blocks, on rotary shears, with hand snips and hand punches.

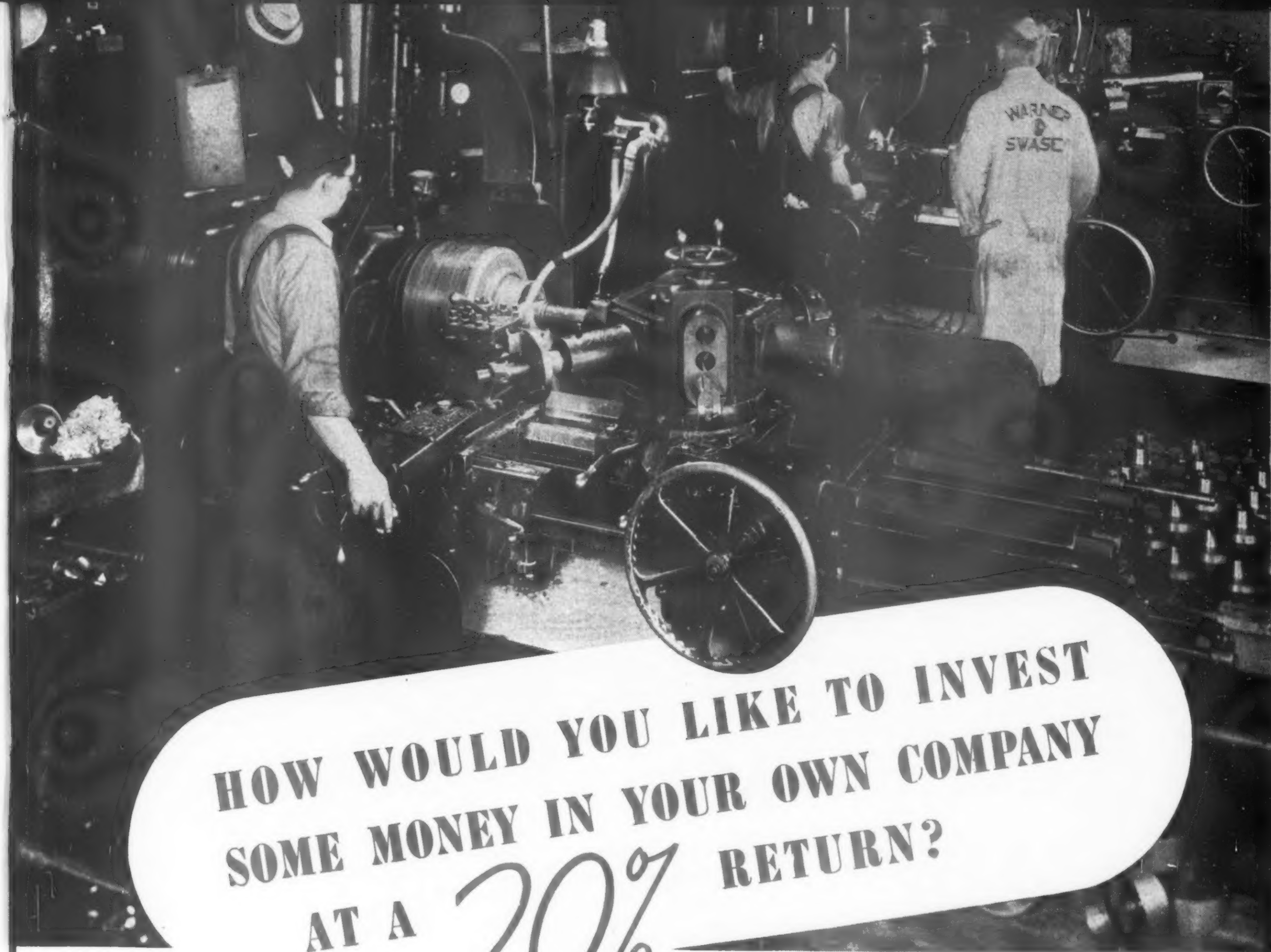
Let us assume another hypothetical case in which the following figures would prevail:

1st	Cost of medium production dies	$22,000
	Cost of low production dies	$12,000
	Difference	$10,000
2nd	Production Cost—Low Production, per stamping	$5.50
	Production Cost—Med. Production, per stamping	$3.53
	Difference, per stamping	$1.97

These figures would indicate that if the ultimate production were not to exceed 2,500 pairs or 5,000 stampings the low production operation line up should be used.

From the figures just presented it is evident that there is no rule of thumb which permits the Tool Engineer to make snap judgment on the most economical operation line-up required for a given job. It is necessary that he be in command of full information pertaining to the quantity and quality of production of the stampings required. That he have a full knowledge of shop conditions and costs in his plant and that he be informed of delivery and rate of production.

This means that there must be closest cooperation between sales department, estimating department, planning department, tool room, production department, engineering department and Tool Engineer.



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DISCUSSION -- Punches and Dies

By FRANK D. O'BRIEN
TOOL DEPARTMENT, MASTER MECHANIC
EASTMAN KODAK WORKS,
ROCHESTER, NEW YORK

IF YOU don't mind, and I don't think you will, I will discuss Mr. Reed's paper first. I think you will agree that he read a very interesting paper. But I am extremely limited in discussing Mr. Reed's paper, for after speaking briefly of literature and books regarding formulae and calculations of supplies and products, his entire paper was devoted to the necessary stages in the development of a blankholder purchasing die for front fenders on a modern motor car. This is a specialized job. Mr. Reed mentioned large universal perforating dies. I can readily see where this type of die is a great timesaver on large work. I wish that they could be made for small work, but this is impracticable, due to the space necessary for the adjustable punch and die holders.

Mr. Reed also tells of metal of low melting temperatures. The greater field of use for this is on very large dies, but we can share it with him in a limited way. The quick acting toggle clamps are now being made in small sizes, and are being used on small milling fixtures and the like, and also in some instances on punches and dies.

Mr. Reed states that the die designer is accomplishing his purpose in that he is designing tools which permit the production of larger stampings cheaper. I believe that this is true on stampings of any size. I think he covered in great detail and very clearly the complicated process of developing the blankholder for fender dies, but it is obvious that due to the single subject, it does not serve for a lengthy discussion. To have made a lengthy discussion possible it would have been necessary to cover the entire field of large dies.

However, we may still get even with Mr. Reed during the question period, and those of you who specialize in large dies can give him a good workout at that time. * I do know, however, the builders of large punches and dies have one thing in common with all builders of dies. If he is doing his job right he has to make a complete analysis of all conditions in order to arrive at the lowest parts cost.

General Field of Punches and Dies

Mr. Forde also has written a very fine paper. He has covered the general field of punches and dies rather extensively. I agree with Mr. Forde that the very low production dies are, with a few minor variations, handled pretty much the same, generally. In our plant this type of work is done in a separate department. We salvage old die sets and send them to this department. Usually a set can be found that requires very little time to mount. It often pays to do this for runs as low as 2,500.

Piercing Dies

I do not recommend piercing dies with solid or overhang strippers other than on very low production as efficient locating and ejection is difficult to achieve, and where accuracy is required the guiding of punches and strippers is necessary.

I would like at this time to get away from the discussion for a moment to read to you a part of a paragraph from a trade circular which is supposed to be quite up to the minute. It has to do with piercing dies. The caption is "Piercing Holes in Thick Stock."

"A piercing punch held in a thick punch plate and backed as shown, and guided in a stripper, bushings, will punch holes in material 30 to 35 per cent thicker than its own diameter." I think 35 per cent is all that is possible from the type of construction shown in the circular, but with the proper design die it is practical to perforate certain materials where the material is 135 per cent greater than the diameter of the punch, for we will successfully, in production, without excessive maintenance costs, pierce .075 mild steel with a .035 diameter punch, or .093 thick brass with the same size punch, .035. It is no trick, just good workmanship and proper tool design. This has been done to my knowledge for more than 25 years, but this paper led me to believe that it isn't generally known.

Compound Dies

Mr. Forde sets a limitation of slow operation and high tool cost. I don't quite understand what he meant when he spoke of passing the blank through the scrap as a hindrance to its quick ejection because we operate compound dies where the operator holds his foot on the treadle catching every stroke of the press, and if production is large they are run on low feed presses. In each case the blank is ejected at the top of the stroke with a positive knockout and is blown from the die by air. The cost is minimized by stock parts such as he mentioned, die blocks, strippers, pad blanks and knockouts.

Shaving Dies

It is perfectly all right to add shaving stages to progressive dies or single station dies. If the quality of the shaving is not too critical, for you cannot get the best quality of shave on an ordinary press, the speed is too fast. On a die where only shaving is done you can improve the shaving if you have a variable speed motor on the press. But to get the best shaving job it should be done on a special shaving press, where the ram is actuated by cam, the speed during actual shaving is very low.

If you took a well made shaving die and were to run it on a shaving press and then on an ordinary press you would hardly believe that the two parts came out of the same die, there would be such an improvement in quality of the one run on the special shaving press.

Progressive Dies

Mr. Forde's complete coverage of this type of die leaves little doubt of the predominant type of die at his plant.

Under the caption of "Single Station Dies—Primary Operation," Mr. Forde justifies the making of single station dies by saying that single station dies should be restricted to simple blanks or to pieces where parts designed, size and complexity, eliminate the possibility of more than the blanking operation. He concludes by saying the single station die has a relatively small field of use. He disposes of a compound die for primary operations by saying, "Viewing the entire field of primary operations, the number of parts which require the use of compound dies is relatively few and its field of use small."

This may be perfectly true at the plant where Mr. Forde is employed, and if he so stated we would have no quarrel with him, but I think you will agree that there are many plants where the conditions cited by Mr. Forde to justify the use of the single station and compound dies for primary operation are so numerous that the number of single station and compound dies made would be quite considerable. To prove this, I would like to explain to you a set-up at our plant. I think it will show the opposite extreme.

By that I mean that due to the amount of production, physical characteristics, and allowable tolerances, the predominant die at our plant will not be the progressive die. Due to a multiplicity of models our production, comparatively speaking, with but a few exceptions, is not very large. The life of our models is not very long; from two to three years is practically the longest-life model we have on the regular camera production. 50,000 parts per year is considered a large production. The greater number of parts would not exceed 25,000 per year. The few exceptions mentioned may run from 200,000 to 1,500,000 parts per year, and with production of that amount we make parts complete wherever possible on high-grade progressive dies. This larger production is on the parts of our lower-priced products on which the tolerances are more liberal. The parts of from 25,000 to 50,000 production per year are from our higher priced products.

Many parts have very complicated shapes and very close tolerances. For example, plus .001, minus nothing is a common dimension on center distances between holes. Plus or minus .002 is common on the relation of forms. On many of our multiform levers we have some parts which require ten or twelve press operations.

I wanted you to get this picture so

(Continued on page 68)

*Editor's Note—Questions and answers cannot be published herein, for lack of space. Get complete transactions from A.S.T.E.

New Production Equipment

A vast array of new production equipment is being introduced continually. The tempo of production as well as the machines and new tools that set the modern production pace is something every Tool Engineer should keep up with. On these pages appear only selected items, brand new, for your quick perusal.

● National Broach and Machine Co., Detroit, announces an extra heavy duty Red Ring Shaving Machine, in which the main characteristics (outside of design) are extra strength and rigidity. It is claimed that rigidity is so great that cuts of .002" over pins, which is approximately .0003" on a side, can be taken with exact measurements after each cut. This indicates that a true cut is taken, that there is no burnishing action due to excessive pressure.

Following the modern "waterfall" trend in design, which imparts extreme ruggedness with graceful lines, the Red Ring Shaver makes use of a gashed helical gear form tool in mesh with the work gear, with the axes of work gear and cutter crossed at an angle—usually 10 to 15 degrees. The cutter gear drives the work gear, as the latter is traversed back and forth across the cutter. This removes stock in fine, hair-like shavings, with a true cutting action in which tooth profile, index, eccentricity and helical angle are corrected and a bright, smooth surface produced. It is claimed that horizontal serrations (washboard effect) is eliminated, and that the generating action corrects profile to within .0001".

The design of the machine, as illustrated, speaks for itself; full details and specifications can be had from the maker.

● Rockford Machine Tool Co., Rockford, Ill., is out with a new line of Hy-Draulic Shapers, 16, 20, 24 and 28 in. capacity. These machines appear to have basic performance advantages, are in line with the trend to hydraulics. The makers claim 442 cutting strokes per minute, as compared to 122 with mechanical action, while faster reverse and speedier return are also effected. A descriptive circular, available on request, gives full information of these Shapers as well as other Hydraulic tools.

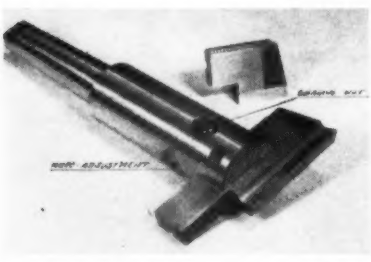
● Walter A. Behr, of Detroit, has developed a simple but interesting tool which, at first glance, may be said to be as "old as the hills"—at least, as old as the boring, spotfacing and counterboring of holes. But the tool illustrated is claimed to be new.

The tool is the result of extensive research by the inventor, a specialist on boring problems, and was primarily designed for boring holes in header die blocks a tough job for any boring mill operator. With the micro-adjustable blade in the holder shown, which insures squareness, it is claimed that such operations can be performed "in jig time." The illustration is clear so that complete description is not necessary. Readers requiring further information may refer to Mr. Behr direct at 5627 Lemay Ave., Detroit, Mich.

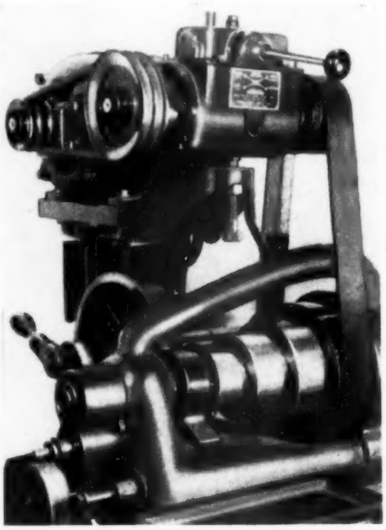
● Western Manufacturing Company, 3428 Scotten, Detroit, Mich., announces a four speed transmission for application to cone driven machine tools. Of Auto Type, change of speed is effected with the ease of shifting gears in an automobile. There are three models:—sizes, rather—the Master for 1 to 5 HP, the Major for 5 to 10 HP and the Super, which is built to specifications to suit load requirements. The transmission is precision built, with anti-friction bearings and all moving parts running in oil. The four selective speed ranges (forward and reverse) are, 1 : 1, 2 : 1, 3 : 1 and 4 :1, operate through one lever. For complete details write the maker, mentioning THE TOOL ENGINEER.

● Charles E. Elmes Engineering Works, Chicago, Ill., is out with a general purpose Hydraulic Press, here illustrated. Of welded steel construction, the tool is simple and sturdy in construction, with control equipment located within the housing. Only the motor starter button and operating lever are exposed. Pulling down lever, platen advances at a high rate of speed, slows down automatically when work is reached. Reverse stroke is considerably faster than power stroke. The press is available in almost any size or capacity, with complete engineering data available from the manufacturers.

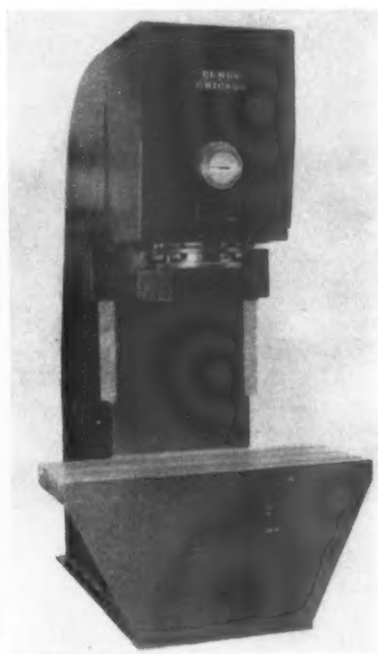
● The Brown & Sharpe Mfg. Co. of Providence, R. I., has added to their line of Attachments for their Nos. 20, 22 and 23 Plain Grinding Machines a "Revolving Spindle Headstock Equipment," which is designed for use when the requirements of the work call for a chuck, spring collet or driving center and when the full table capacity of the machine is not required and, therefore, the installation of a Motor-Driven Revolving Spindle Headstock is not warranted.



W. A. Behr, Detroit, is the inventor of the boring tool illustrated above. Unusual feature claimed for the tool is the micro-adjustable blade, which is said to insure squareness.



The four speed transmission recently introduced by the Western Manufacturing Company, Detroit. Speed changes are effected, it is said, with the ease of "shifting gears" as in an automobile.



Chas. E. Elmes Engineering Works, Chicago, has announced the general purpose Hydraulic Press pictured above. It is of welded steel construction, and is available in almost any size or capacity.

Brown & Sharpe have added to their line of attachments for their Nos. 20, 22 and 23 plain grinding machines a "Revolving Spindle Headstock Equipment," shown above, and described here.

It consists of a spindle mounted on sealed pre-loaded super-precision ball bearings and carried in a sturdy casting which is clamped in position on the table ways at the right of the headstock of the machine. The spindle is driven directly by the work driving plate of the regular headstock. Use of this unit reduces the length capacity of the machine by 14".

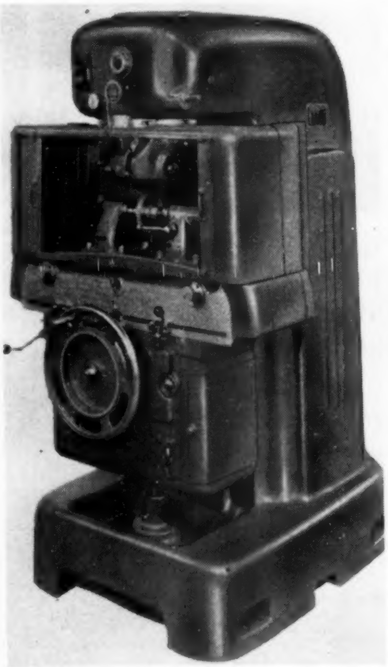
The front end of the spindle is threaded, 4 R.H., Ntl. Std., 2¾" diameter. It has a No. 11 B & S taper hole; and the straight hole through the spindle is $1\frac{1}{16}$" in diameter. The revolving Spindle Headstock Equipment is furnished at extra cost, and must be fitted to the machine at factory. Net weight, 140 lbs. (approx.).

● Barber-Colman Company, Rockford, Ill., announces the new, improved B-C No. 4 Hob Sharpening Machine, which is designed for automatic re-grinding of hobs and formed milling cutters. As will be seen from the illustration, the machine is a typical Barber-Colman design, clean cut, well proportioned and built to cut costs. Unusual care seems to have been taken to enclose all moving parts against abrasive action, also, hydraulic table traverse insures a smoothness and positiveness not usually found in mechanical drives. Full description of machine is to be had in a new circular, available from the makers on request.

The new Barber-Colman improved B-C No. 4 Hob Sharpening machine, illustrated above, is designed for automatic re-grinding of hobs and formed milling cutters.

● Allegheny Ludlum Steel Corporation, Watervliet, N. Y., has developed a new Steel Making process which is known as Pluramelt, differs from single composition ingots produced by Bessemer, open hearth and electric furnace processing by making possible more than one composition or analysis in a single, final ingot.

The new process, which started out to be a development of stainless steel, makes an interesting story for those interested in steel (and what Tool Engineer isn't?,—but is too lengthy for review here. We suggest that those interested write the makers for the story of an important development in steel processing.



Shown above is the new extra heavy duty "Red Ring" gear shaving machine, recently introduced by the National Broach & Machine Company, Detroit, and described fully on page 26 of this issue.

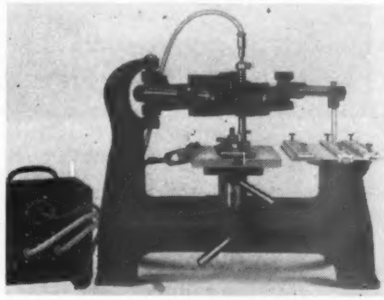
● Reed-Prentice Corporation, Worcester, announces the No. 3 VG Vertical Milling and Die Sinking Machine. This machine, which incorporates back geared spindle construction, supersedes the previous 3 VG machine without the back gears. The construction of spindle (illustrated with gear guard removed) is extremely simple yet positive, while simplicity and clean lines are a characteristic of the general design.

While standard equipment includes machine arranged for vertical motor drive, drawbar, No. 3 collet adaptor and ½" collet, extra equipment is available which provides an unusually wide range of work, including precision jig boring. Full description of machine, with specifications, are detailed in Circular 18-3 VG, available on request from Reed-Prentice Corp.

● Something new that replaces an old stand-by is Dykem Hi-Spot Blue No. 107. Used for scraping bearings, fitting slides, etc., this new product does not dry out or gum and is uniformly consistent. Tool room superintendents who are looking for a time saver should get the details of Dykem Hi-Spot from the makers, the Dykem Company, 2301 N. Eleventh St., St. Louis, Mo. Mention Tool Engineer.

● A new bench-type pantographic machine for general industrial engraving work on all materials, and electric etching on soft or hardened steel, has been introduced by H. P. Preis Engraving Machine Company, 157 Summit Street, Newark, New Jersey. Separate heads, quickly interchangeable, are used for the two classes of work.

On engraving work, depth of cut is controlled, independent of the depth of master characters, by a micrometer adjustment mechanism on the engraving head. Movement of the engraving cutter, to and away from the work, is controlled by a cam-action drop lever, thus eliminating the necessity of raising and lowering the pantograph. Either raised or sunk engraving can be produced. For engraving on uneven surfaces, on slightly concave or convex surfaces, or on objects varying in thickness, an automatic depth-of-cut regulator is furnished.

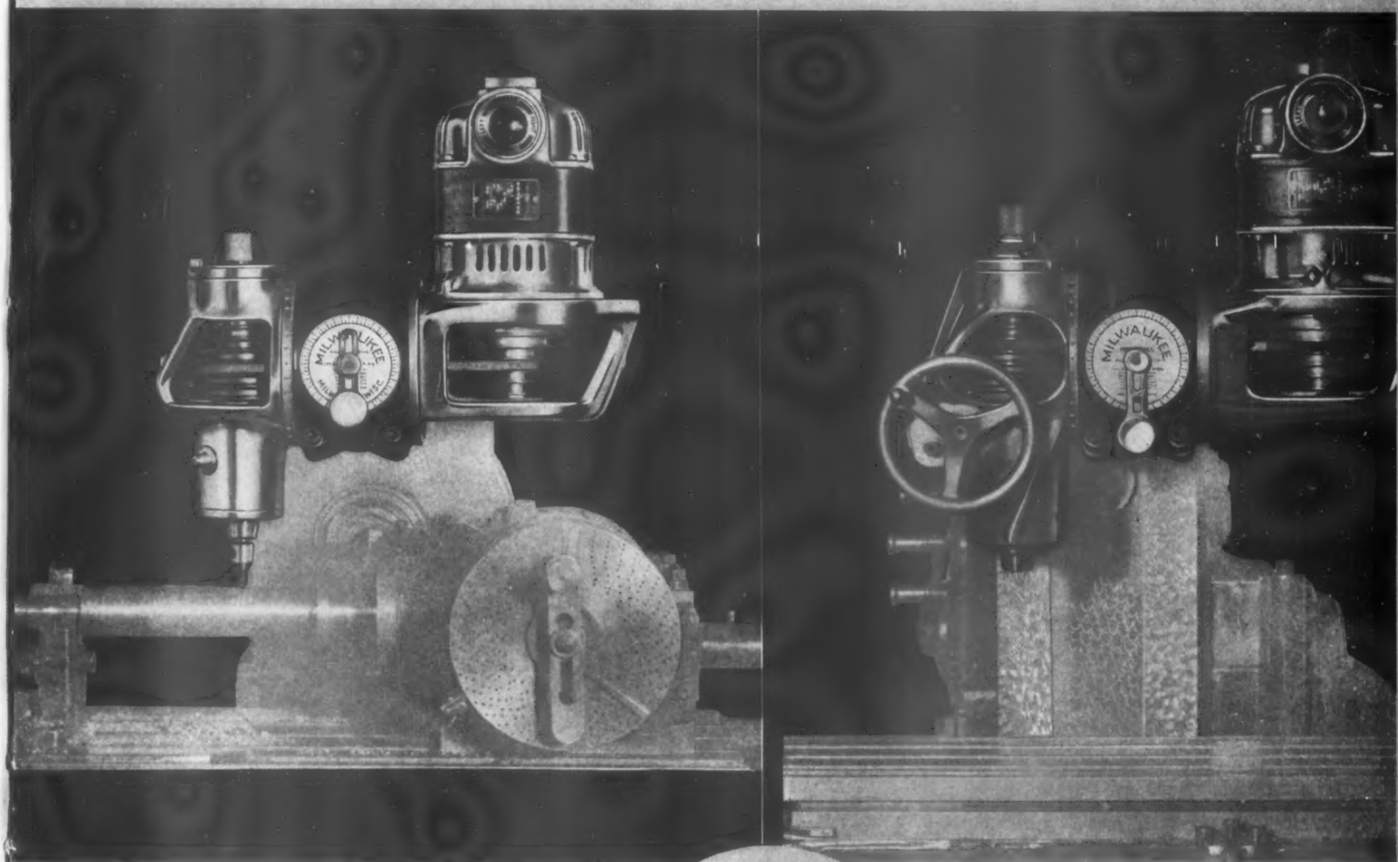


New bench-type pantographic engraving machine for general industrial engraving work on all materials just introduced by the H. P. Pries Engraving Machine Company, 157 Summit Street, Newark, New Jersey.

The compactness of this unit, and the fact that it can be plugged into any light socket for instant use, are features that should recommend it for a wide range of industrial and commercial work. Illustrated folders on the machine, and on master copy type for use therewith, will be sent upon request to the manufacturer. Mention Tool Engineer when writing.

● A line of Static and Dynamic Balancing Machines for locating and measuring unbalance in rotating parts is announced in a new booklet recently released by Gisholt Machine Company. Detailed explanations of the effects of unbalance in rotating parts are included in the booklet, which also contains diagrams and descriptions of the underly-

(Continued on page 65)



Production Perspectives

News of Mass Manufacturing from Everywhere

IF the United States went to war today it would take 12 or 15 months for American industry to supply 2,000,000 soldiers with necessary equipment, members of the **Cleveland chapter** of the **American Society of Mechanical Engineers** were **told** the night of April 11 **by two United States Army ordnance officers from Washington at a meeting in Guildhall, Cleveland. This was revealed in a discussion of the "educational orders" program under which the government is making an exhaustive study of the industries which, in time of war, would be called upon to produce 90 per cent of the war materials.** The **speakers were Col. H. K. Rutherford, director of the planning branch of the ordnance department, and Maj. D. N. Hauseman,** attached to the office of the chief of ordnance. An **appropriation of Congress** has **permitted his department to purchase from plants earmarked for war work a complete plan of their operations in conjunction with educational orders, Col. Rutherford said,** adding that in this way a major part of the 10,000 plants which fell in that classification had been reached. He explained that **an educational order was a call for a small production of some critical item of munitions on a competitive basis. One hundred and fifty million dollars was spent in orders in the last fiscal year,** according to Maj. Hauseman, approximately **two-thirds of it going to private industry. The major said that the six United States arsenals were working almost to capacity now and that it was the policy of the government not to expand their operations in time of war.** "We are **not producing any more munitions now than we did in 1917,"** he pointed out, "but we **have the advantage now in knowing where they would come from if we needed them."** The **United States would need about $500,000,000 in tools and it would take industry at least a year to produce them, Maj. Hauseman said.**

The **Engineering Foundation in New York City, established by the late Ambrose Swasey, founder of Warner & Swasey, has carried on 73 research projects involving an aggregate of $3,111,374 since its founding in 1914,** according to a report released by the foundation. The report also revealed that the **late Cleveland manufacturer had made five gifts to the foundation totaling $818,600** for the furtherance of research in science and engineering. **"Notable contributions have been made to science, engineering, industry and the humanities during a 25-year period characterized by profound change," states Dr. Otis E. Hovey, director. With** the **co-operation of 88 manufacturers, research institutes, technical societies and federal bureaus,** hitherto **inaccessible world knowledge of steel and iron and their alloys has been assembled by the foundation** from scientific and technical literature of many nations.

Unemployment insurance has "contributed to destroying hundreds of thousands, if not millions, of jobs in this country," Administrator H. C. Atkinson of the **Ohio Bureau of Unemployment Compensation charged March 22.** The **remaining jobs,** he added, "are **probably better jobs than before, with improved income to the retained worker." Admitting that unemployment insurance has greatly aided "surviving employees," and has helped stabilize the credit system** on which American business is based, **Mr. Atkinson called for a frank new analysis of the results of social security taxes and benefits.** "Our **problem is what to do with the surplus of the now displaced workers,** an **army more likely to increase," said Mr. Atkinson. "This is the legion of the permanent WPA, PWA and the relief rolls,** unless we find some way to change the present trend. **Social security taxation did not produce this phenomenon;** seemingly **it speeded up** a process already taking place. The **efforts through subsidies and doles, through made-work and federally financed relief aid, have not pegged or stemmed a dangerous trend.**

John Sauer, Jr., President of the Associated Machine Tool Dealers of America, has **announced the selection of Atlantic City, New Jersey, as the place of the Spring Meeting of the Association** to be held on Monday and Tuesday, **May 13th and 14th.** The Claridge Hotel will be the Convention headquarters.

Postponement for two or three years of the army's goal of 5,500 fighting planes by June 30, 1941, was revealed shortly after the Senate military affairs committee at Washington added its approval to the administration policy of selling newly-developed United States warplanes to the Allies. Abandonment of the 1941 deadline for the army's expansion program **was disclosed by Gen. George C. Marshall, chief of staff, who told reporters the War Department had decided to watch new aerial developments in the European war in an effort to avoid stocking up with planes which might become obsolete in a short time.**

Assistant Secretary of War Louis Johnson on April 8 **awarded** an **$8,000,000 contract to the Boeing Aircraft Co., Seattle, Wash., for** approximately **50 new four-engined "flying fortress" bombers.**

The Peden Iron and Steel Company, Houston, Texas, of which Mr. Geo. T. Morse is Manager, **has recently been made the Barber-Colman representative in the Texas territory.** They are authorized to handle the sale of the entire Barber-Colman line of Hobbing Machines, Hob, Cutter and Reamer Sharpening Machines, Hobs, Milling Cutters, and Reamers.

With the **biggest backlog of orders in its history, Progressive Welder Company,** designers and manufacturers of resistance welding and hydraulic punching equipment, **has begun production in its new, modern office and factory headquarters on East Outer Drive, Detroit, Michigan.**

Contract has been signed for **erection of two buildings for the Sterling Foundry at Wellington, Ohio, R. E. Clisby, Sterling president, said. Expansion coincides with** an **expansion of the Warner & Swasey Co. factory in Cleveland** for which nearly all Sterling Foundry castings are made.

Harry Woodhead has been elected president of Aviation Manufacturing Corp. to succeed W. H. Beal who **resigned** because of ill health. His **new duties will place him in charge of activities of the Stinson Aircraft Division,** commercial and military aircraft builders; **the Lycoming Division,** makers of aircraft engines and propellers, and the **Spencer Heater Division,** manufacturers of boilers and heaters.

A **rayon cord tire which is 3000 per cent sturdier** than standard cotton, **has a higher tensile strength than structural steel,** and **ran 80,000 miles under conditions which destroyed an ordinary tire in 3000 miles, was described to the 99th meeting of the American Chemical Society at Cincinnati. William H. Bradshaw,** director of rayon research for **E. I. Du Pont De Nemours & Co., said a new rayon developed specifically for tires has produced "astounding results"** in road tests involving millions of miles.

The **White Motor Co. of Cleveland** has received a **$1,250,000 order for 145 huge 25-ton gasoline transport trucks from the French government. Delivery** must be **completed** by **June 1.** This **order follows recent delivery of 1500 smaller White transports costing $3,000,000** to the French government. **These orders,** together with those received from the United States Government, **make a total of approximately $7,000,000 worth of domestic and foreign military business placed with the Cleveland firm during** the **past six months.**

. . . A. S. T. E. DOINGS . . .

Buffalo Chapter had a special meeting April 1, when a free dinner was served to sixty-five members who had turned out to witness the installation of the newly elected officers. A business meeting was also held to formulate plans for the coming year. J. Don Reep, "Godfather" of the Buffalo Chapter, commended out going officers for the excellent advancement of the chapter in the past year and gave words of encouragement to incoming officers and also praised the general membership for their co-operation in making the past year the best yet for the Buffalo-Niagara Frontier Chapter.

The regular meeting of the chapter was held April 11, and Mr. Walter Bailey, Sales Manager for the Warner & Swasey Company, presented a talk on "Turret Lathes and Telescopes" which was accompanied by slides and moving pictures.

St. Louis Chapter with D. D. Burnside in the chair, held its monthly dinner meeting Thursday, April 11th, at the Melbourne Hotel. The speaker of the evening was Mr. J. V. Emmons of the Cleveland Twist Drill Company, who gave a talk on the subject "The Molyddenum Tungsten High Speed Steels". Mr. Emmons presented his subject in a manner that made it clear and interesting to all present. With an eye toward summer, the members voted to hold a picnic in July at some secluded spot far from the city. Ask Ed. Doogan why?

Cincinnati A. S. T. Eers were given a treat at the April 9th meeting of their chapter when Ford Lamb, Executive Secretary, and A. J. Snyder, of Morse Twist Drill and Machine Company, were the speakers. The meeting was well attended and was held at the Ohio Mechanics Institute. Chairman Lou Weber gave a summary of plans which had been made to date for the Semiannual National Meeting in Cincinnati next October. Mr. Lamb gave an outline of A. S. T. E. progress as a National Society and spoke of trends in Tool Engineering and Education. Mr. Lamb also installed new Cincinnati Chapter officers as follows: Chairman, Jim Frederick; Vice Chairman, Tom Kling; Treasurer, Charles Carr; Secretary, Wm. Averill. Mr. Snyder gave an illustrated lecture on various tools and their application, which was well received and of particular interest to the assembled Tool Engineers.

York, Pennsylvania, Chapter No. 22, held its April meeting at the West York Inn. Mr. Joseph Devorss, Development Engineer of The U. S. Rubber Company, spoke to the chapter on "Developments in the Mechanical Uses of Rubber". An open discussion followed the talk which was so lively that the chair had to put thumbs down in order that the boys could get home to their wives during the night. The movie, by U. S. Rubber, was very interesting.

Worcester Chapter, April 8th, meeting was honored by the presence of National President, A. H. d'Arcambal, and three gentlemen from England, members of the English Society, Institute of Production Engineers. Photographed at the meeting, reading left to right were—Charles Bank, Secretary Worcester Chapter; Clinton Johnson, Chief Gage Engineer of Pratt & Whitney, Speaker of the evening; A. H. d'Arcambal, National President; Leslie Goff, Treasurer of Worcester Chapter; Ray Cole, Chairman of Worcester Chapter and Carl Lindgren, Vice-Chairman of Worcester Chapter.

Hartford Chapter is the very proud possessor of the National A.S.T.E. Membership Cup. Shown below, with the cup, reading from left to right, are A.E. Englund, Membership Committee Chairman; Ray H. Morris, Chapter Chairman, 1939-40; F. L. Woodcock, Incoming Chapter Chairman, 1940-41.

The following officers, who were elected in March, were installed by our National Secretary, Conrad O. Hersam, to their new offices: Chairman, R. E. Wentzler; Vice Chairman, H. G. Wiest; Secretary, M. G. Leesen; Treasurer, E. F. Noel.

It was decided that the May meeting will be Executive Night and another lively program is anticipated.

Syracuse Tool Engineers, at the April dinner meeting, turned out 83 strong to hear Mr. Arthur Keetch of the Warner and Swasey Company, very ably pinch hit for Mr. Walter K. Bailey, the scheduled speaker. The topic of the evening was "Telescopes and Turret Lathes".

In the absence of Mr. Conrad Hersam who was unfortunately detained, the out-going chapter chairman, Mr. A. H. Mitchell, inducted the recently elected officers into their new responsibilities.

Mr. Mitchell, acting as chairman of the 1940 membership committee, also

(Continued on page 56)

Handy Andy Says —

AMONG recent letters, from scattered points around the country, are several reminiscent of the springtime of life when the future was a glorious vista and hope was as wide as space itself. Well, many futures have become pasts since then, drifting along with the tides that roll under the bridges of time; here we are, in Today, and the planks in the span of life are grooved with the tramping feet of those who have preceded us to the ultimate goal. But, it's been a great game, nor has the zest diminished; the future, as far as America is concerned, is safe as long as young men aspire and graybeards sign ninety-nine year leases. But thanks for the greetings, gentlemen; they gave me real thrills of pleasure.

In writing this column, there have been many pleasurable moments, when —random shots reaching their targets— my verbal arrows have come winging back with return messages tied to their shafts. Somehow, this column reminds me of my grandmother at her loom; she'd sit there, the winter evenings, her gentle face suffused by the soft glow of the firelight, feet and hands working in practiced unison. Tramp, tramp!— the shuttle slithered to and fro until by and bye the orderly tangle of threads would resolve themselves into a patterned fabric, firm and enduring. I would like to feel, when I write FINIS at the end of the column one of these days, that somehow it has been a shuttle criss-crossing the threads of friendship and acquaintanceship in the strengthening weft of the A.S.T.E.

The Good Book says that "He that giveth his life shall have it." Sometimes, I wonder. I run across various old timers (they're still in the prime of life) whose untiring work gave an impetus to the Society that just sent it rolling along into the first division. There was (is) Al Sargent, now well on his way toward a captaincy in industry, to whom the A.S.T.E was a near religion, and he is but one of many. I recall the Standards meetings, of which Al was secretary and Bill Smila chairman, when the Committee would "bone" and check until midnight; the Executive Committees when the order was young. Then, smiling Ray Brunner and faithful Frank Crone would still be poring over their books when, at 2 A.M., others would flex fingers stiff from sorting and wrapping and get ready to take the mail to the post office. Men, you've got to have faith in a thing to work like that! Oh well, the old order changeth and the Society now rolls on ball bearings, just like the modern stream-liners. May it stay on the track, and in passing wonted pastures, deal kindly with the wheel horses that pulled the coach in less glamorous days.

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From one thing to another, we've got an addition to the family. Her name is Susie (to which younger Dotta added a Q) and she is a two months old cocker spaniel pup as full of life as nine cats. Of course, pups require a lot o' care and upbringing, which (being of an inventive turn of mind) I could reduce materially if the family'd just let me pin diapers on her. For she piddles here and phews there, discombobulates* things in general, but, she's a pleasure and joy regardless even if the silk stocking and shoe bills run up something scandalous. Now, if any of you dog fanciers with experience will give a few bona fide tips (no phoneys, now!) they will be greatly appreciated. My previous dog (when I was seven) was a cocker spaniel that had been a circus dog, and the tricks Nero could do! One, that finally resulted in his going to the dog house, was a penchant for ripping the clothes off the neighbors' lines and piling them on our piazza. "Love me, love my dog"—but the wear and tear was just too much. Ah well, we'll not bring up Susie that way.

(Continued on page 36)

*** Don't look for it in the dictionary; it's a new word invented for the occasion.**

HANDY ANDY SAYS

(Continued from page 34)

Looking through our advertising list, I see many names I haven't got around to, among them National Twist Drill & Tool Co. And as usual, I'll have to speak of my acquaintanceships with individuals, not knowing so much about the "big shots" except that they foster quality products. But Carl Oxford, who I believe is Chief Engineer, has been a considerable force in building up the A.S.T.E., among other things. Carl, whose middle name is thoroughness, and can usually be depended upon for an interesting technical article or dis- * has the knack of making things move cussion. Another A.S.T.Eer whom I hold in friendly regard is John Nelson, by way of being development engineer for National. John is noted for several things; size, an inimitable but infectious laugh and a keen knowledge of Tool Engineering in its finer points. Best regards, Carl and John.

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I also note that Detroit Power Screwdriver Co. is with us, and I remember them well for the feed hopper they've developed and which, to say the least, is "the berries." I've had occasion to apply a number of them to some of my later ideas for making two blades of grass grow where only one grew before, and so far, no regrets. I see, too, where Racine Machine & Tool Co. is on our lists, and again, I'm an absolute stranger at Racine headquarters. But, they had some mighty interesting hydraulic equipment at the previous Tool Show, and they've improved plenty since then judging by latest bulletins. I count Fred Hebert, Detroit representative, as one of my personal friends and proud of the connection. Keep 'em pumping, Fred!—you've got a good line.

▼ ▼ ▼

Am particularly pleased to see Sundstrand Machine Tool Co. in our pages after an absence. Sundstrand, I believe, is one of the pioneers in modern trends of machine design—the Rockford movement, isn't it? Anyway, they produced a manufacturing lathe during the late world war (into which I hope this won't develop since I didn't want a permanent blockade on Norwegian herring) which made the rest of the gang take notice. Sundstrand, it seems, has played with about everything from soup to nuts and each product has been something better than we had before, has been an inspiration to industry. Well, that's industrial progress; you make something better, then someone else laps you, then you take a spurt and keep the race going.

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Barber-Colman is another Rockford concern that is doing things with design. Emulation and competition is creating a styling and efficiency in the machine tool field that is as distinctive as the smoothening trend in the automotive field. Modern machinery is taking on the refinement and sleekness of fine furniture, and demme if the Execs. in the front offices won't have to quit doodling on their old desks and install the latest in waterfall modern. Else they'll be shaming the boys who run the pastel shaded modernistics out in the shops. Well, that's all for now and don't forget the advice to anxious (dog) lovers. For Susie's sake. And for now, au revoir.

Handy Andy

More New Chapters of A.S.T.E Being Formed

"There's no stopping the A.S.T.E.," says Roy T. Bramson, Chairman, National New Chapters Committee. "With thirty-two operating chapters, and a membership of close to five thousand, all in less than eight years, the American Society of Tool Engineers is the fastest growing technical Society in the world."

Within the next few weeks several more new chapters are to be established. Tool Engineers of Indianapolis have indicated their interest in chartering a chapter and will be organized there very soon. Brooklyn, New York; Columbus, Ohio; Birmingham, Alabama; Erie-Meadville, Penna.; and Akron, Ohio, are among other cities which will apply for charters soon.

TOOLS FOR PLASTICS

(Continued from page 13)

Clamps are preferred to direct bolting as only a few holes need to be drilled in the platens for clamps and these holes are used for various sizes of molds.

Should the cavities be chrome plated? The use of chrome plating in the cavities has its advantages, although not a necessity, in keeping the materials from sticking and also keeps it from staining and rusting.

What steels to use? What pressures these steels must withstand? Compression molding pressures usually run from 2,000 lbs. to 10,000 lbs. per square inch and injection molding from 20,000 lbs. to 50,000 lbs. per square inch. Steels used in the cavities must withstand these pressures without mushrooming, chipping, or cracking and the shoes must stand up under these pressures without allowing one cavity to sink below another, and must support the side walls of the cavities.

The finish in the cavities bears an important relationship to the finish of the part produced, for every scratch, blemish, and stain is reproduced on the molded part. The better the finish the smoother and shinier the part, the less buffing and polishing necessary to remove the appearance of scratches, spots and stains.

Tool Room Skill—Essential

Our next picture takes us to the tool room. Here the procedure is to follow the usual method of mold construction. The fits must be accurate so that material will not be pressed into joints thus causing unnecessary labor in cleaning off these fins. The matching of upper to lower cavity calls for real skill of the tool maker especially in matching multiple cavity molds. And it is up to him to give the cavity that mirror-like finish desired in a good mold.

Control of Materials

At this point let us bring into the picture the laboratory and its duties. In order to obtain the best results from the plastic materials a check-up of them by the chemist is a big help to the press operator to set the time for curing the material and through tests prevent blistering and warping. All materials received should undergo tests for plasticity, tensile, compression, flexural, impact, and dielectric strengths and for moisture and distortion tests. The closer the cooperation between the laboratory and the press shop the more uniform the finished product. And through the laboratories' efforts the scrap is held to a minimum.

Molding Technique

Now we come to the actual working of the plastic materials. First, we consider compression molding. Materials may be loaded into the mold in powder form or the powder may be pilled or pre-formed. And for this purpose several types of pre-forming machines are on the market to produce from twenty-five to eight hundred pre-forms per minute. Each pre-form contains just the right amount of material to produce one part. The machine makes the pre-forms to within two grams of the correct weight automatically. With the aid of the pre-forms the press operator can load the mold rapidly and cleanly. And for multiple cavity molds pill loaders assist in speeding up the loading time. The loader is made with the same number of pockets as there are cavities in the mold, and the operator fills the loader for the next shot while the press is working. Then when the press is open and ready to load, the loader is placed over the mold, the bottom pulled back and the pills drop into the mold at one time. While the press is closed the operator cleans the flash from the previous shot, prepares the loader for the next shot, and examines the molded parts for blisters, cracks, or other defects and through his control the defective parts can be cast aside and further trouble of this nature be held in check.

In the case of injection molding the material, usually in Granular form, is loaded into the hopper of the injection machine and then it is automatically fed into the press through the heating cylinder and thence into the mold. In the injection machines the molding shots run from one to five shots per minute. And even at these speeds the operator should find time to inspect the molded

(Continued on page 40)


TIME spent in resharpening or replacing the reamer cuts the savings made possible by new machines. For clean, accurate holes, for longer time between resharpenings, for the ability to keep pace with today's machine tools, specify Morse Reamers.

TOOLS FOR PLASTICS

(Continued from page 38)

parts so that he can get the best results from the machine.

Cleaning and Finishing

After molding, the parts are cleaned up and other machining operations performed such as drilling, tapping, grooving, and machining places that are impossible to be molded. In drilling, deep fluted long lead drills produce the best results with thermo-setting materials, and drilling speeds usually run at 150 feet per minute for drills under one-quarter inch in diameter to 200 feet for drills over one-quarter inch. Of course multiple drill heads are in order if there are several holes to drill in each piece. In tapping thermo-plastic materials the taps should be held slightly oversize as the plastic has a tendency to close in after tapping. In the clean-up of thermo-plastic parts small machines such as speed lathes, shavers, and bench drills tooled with suitable cutters for the various operations are faster and more economical than automatic machines.

Polishing

After trimming flash and parting lines, removing gates and sprues, the parts are ready to be buffed and polished. Of course the better the matching of the cavities of the mold the less trimming and cleaning is necessary, and therefore the less polishing is to be done. However, we find it necessary at times to add that extra operation of polishing to restore the luster and beauty of the part after being handled so much in the trimming. For this purpose semi-automatic buffing machines, line buffers, and double end buffers have been developed. We find that several types of buffing wheels adapt themselves very well to plastic buffing. For thermo-setting materials stitched buffs of various materials are suitable and usually are run at speeds from 5,000 feet per minute to 10,000 feet per minute. For thermo-plastic materials softer and looser buffs are more practical, and are run at speeds ranging from 2,300 feet per minute to 5,000 feet per minute. Care must be taken in buffing thermo-plastic materials so as not to burn the material and this is very easily done if too much pressure is applied. If paint or other coloring materials have been used on the plastic parts for decorative purposes, the surplus paint may be removed readily and without burning by running the buffs at the slowest speed or about 2,300 feet per minute. Various buffing and polishing compounds are available and of course a little experimenting is necessary to select the proper type for particular needs.

Applying Decorations

Sometimes it becomes necessary to add lettering, trim lines, and other decorative designs of contrasting colors to the parts. Now there are various ways of doing this. The design may be worked into the mold and then transferred to the molded part. Then this design is filled with the paint selected. This is slow and a messy way of adding decorations, and it is also a more expensive way of making the mold. A more modern way is to stamp the extra colors by means of a special stamping press, a stamp, and a roll of foil. The foil contains the coloring pigments of the color required and is applied under heat. This makes a clear sharp design and can be applied at the rate of about forty pieces per minute. This method also saves considerably on the cost of the mold.

So with this last picture we have taken an imaginary trip through a molding plant and perhaps learned a little of the plastic industry. It is only a small beginning, and the possibilities of the things to come in plastics will some day take volumes to tell. The need for tools, machines, new materials and ideas is great. The need for skilled men; designers, tool makers, machine builders, chemists, and men with ideas is growing daily. And with this in mind let us all add our little bit to boost and promote plastics and help a baby industry grow into manhood, with a big new outlet for labor, and tools.

Positive Proof

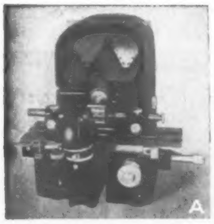
THAT JONES & LAMSON *OPTICAL COMPARATORS* *MAKE PROFITS FOR THE PURCHASER*

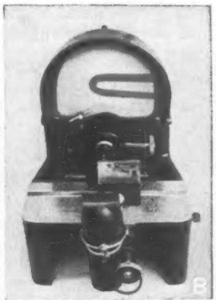
. . . is shown by the fact that one customer has purchased 27 Jones & Lamson Comparators over a period of 13 years.

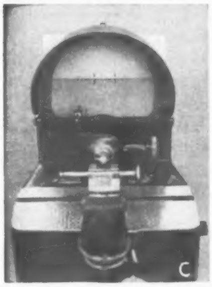
We are proud of this record, not only because of the number of Comparators sold to this customer, but because each year for 13 years he has added one, two or more Jones & Lamson Comparators to his inspection departments. Convincing evidence of their profitable operation.

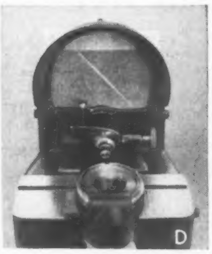
This is but one example of how Jones & Lamson Comparators save time and money in the Inspection Department.

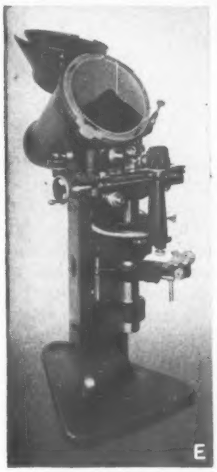
Originally designed for the inspection of thread forms, these Comparators are now universally employed for the accurate and speedy inspection of intricate and precision parts, also parts with generous limits but hard to measure by any other method. Such parts were once inspected slowly and with difficulty by highly skilled operators using expensive instruments. Today profiles are inspected by projection and surfaces by reflection, *accurately, quickly and economically on the Comparator by operators with only a few minutes instruction.*

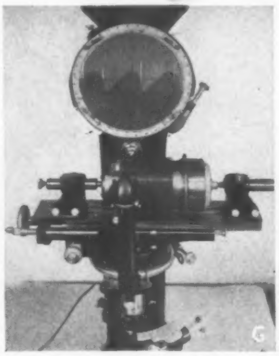












A — Bench Comparator — Inspecting Hob
B — Bench Comparator — Inspecting Knitting Machine Needle
C — Bench Comparator — Inspecting Valve Stem
D — Bench Comparator — Inspecting gap in Piston Ring
E — Pedestal Comparator — Inspecting Diamond Tool
F — Pedestal Comparator—Inspecting Buttress Thread of airplane engine cylinder
G — Pedestal Comparator — Inspecting Buttress Thread of airplane engine cylinder
H — Pedestal Comparator — Inspecting Form Tool Contours
I — Pedestal Comparator — Inspecting Hob

Only a few typical inspection jobs can be shown on this page, but Jones & Lamson Comparators are used to inspect a great variety of different articles.

Submit your Inspection Problems to a Jones & Lamson Engineer. Where the Comparator can be used, a profitable solution will be found.

J&L

JONES & LAMSON MACHINE COMPANY

SPRINGFIELD, VERMONT, U. S. A.

MANUFACTURERS OF: SADDLE & RAM TYPE UNIVERSAL TURRET LATHES . . . FAY AUTOMATIC LATHES . . . AUTOMATIC DOUBLE-END MILLING & CENTERING MACHINES . . . AUTOMATIC THREAD GRINDING MACHINES . . . COMPARATORS . . . TANGENT AND RADIAL, STATIONARY AND REVOLVING DIES AND CHASERS

MOLDING PROCESSES

(Continued from page 14)

Pre-Heating

This pre-heating has become more extensively used today because of advantages, which I will try to explain. Molding temperature is approximately 330° Fahrenheit, and the molds must be heated to this temperature. Now, if a cold- or room-temperature material is placed into the mold, the mold will have to furnish the heat which is necessary for the material to become plastic. Now, remembering that plastic materials are not conductors of heat, we have in a sense a flow condition similar to pressing a tallow candle against a hot plate. The material which contacts the hot mold surfaces becomes plastic and starts to flow. Likewise, the polymerization or curing period starts with the first flow of the material. Now, what is the result of this condition? In an exaggerated sense, it means that the outer surfaces of the molded part cure and set in advance of the center section. It has a tendency to trap gases and also trap steam vapor, which is generated by heating the moisture which the materials pick up. This condition is very noticeable in humid seasons or climates. Such trapping of gas or moisture usually results in porous structure of the molded part and often appears in the form of blisters on the outer surface. Now to repeat that the molding temperature is about 330° Fahrenheit and we pre-heat the molding compounds in ovens to a temperature of about 260°—just long enough for the compound to become somewhat soft. We then place the compound directly into the mold. You can see that the length of time required to bring the entire charge of material up to molding temperature would be much shorter and also we would come a little closer to the ideal molding technique of curing from the inside out.

Proper Closing Time

Another very important factor of molding technique we have found is the proper closing time of a mold. Let us consider this for a moment. Supposing we suspend a wide board in our hand and suddenly bring it down on the surface of a body of water. What happens? The board bounds back. Now—take the same board and lay it on the surface of the water. Very little pressure is required to cause it to sink —just enough pressure to displace the water under it. This is a somewhat exaggerated example but, in effect, the results are the same—the closing time of a mold is in direct proportion to the time required for the material to become plastic, and the time required for the displacement of this plasticized material.

Density

These are a few of the factors which we consider important in order to furnish molded parts with maximum density. Density is also a factor which all molders are anxious to control, particularly to maintain uniform density. There are several conditions which would affect them. One is the uneven heating of all portions of the mold, the proper distribution of molding compound in the mold before pressure is applied—also variations in cross sections cause much trouble because the variation in density causes variations in shrinkage. The result of this variation in shrinkage causes warpage. So, you can see that the molding of extreme accuracy means the accurate control of many unknown factors. Hence, where extreme accuracy is required, machine operations should be performed.

At the beginning of this discussion, I said we would consider the molding of the most common type of Resinous Plastics—the wood filler type. Now, the high-heat asbestos material, also the high dielectric mica fillers are handled in just about the same manner. The high impact materials such as fabric fillers have an exceptionally high bulk factor—some as high as 8 to 1 as compared with 2½ to 1 for the general purpose compounds. This high bulk factor requires exceptionally large loading space. This type of molding material has a disadvantage, that it cannot be preformed in the standard automatic machines. Otherwise, the molding pro-

(Continued on page 64)

INJECTION MOLDING

(Continued from page 16)

due to corrosion and the deposit of a gummy substance left by the plastic material, which had to be removed constantly with acetone. Although a very high polish was possible with the oil hardening tool steel regularly used, constant cleaning and periodic repolishing were necessary for molds where high gloss was essential. Some development was done with chromium plating of impressions to cut down the cleaning and polishing and was quite successful.

Stainless Steel Molds

Another effort to maintain polish for a longer period and to resist corrosion in molds operating in humid climates, was successful with the development of a stainless steel which could be machined and hardened very much like tool steel. This stainless steel could be polished to any desirable finish and could be kept this way for long periods by occasional cleaning.

All of these advances in mold construction were accomplished by men already experienced in the manufacture of molds for other purposes. It was necessary for them to work closely with the material and machine makers as well as the men doing the actual molding in order for them to gain the experience they now have.

I have covered in some detail the development of the injection molding of Thermo-plastics and will now discuss in a more brief form the accomplishments which can be expected in the near future.

Accomplishments Expected

The plastic material is the first to be considered because its future determines the future of injection molding itself. One of the strongest demands now made by users of parts molded by injection is for materials with the ability to maintain their original physical properties and dimensions for much longer periods of time than is now possible. Another demand is to make molded parts capable of withstanding much higher and lower temperatures than now possible while remaining unchanged from their original specifications.

These conditions have come about because users of injection molded parts are now at the point where the value of their products is just as dependent on the quality and long life of these molded parts as on anything else they use. Because of this we can be sure to see all the demands met and exceeded, judging from past performances of the material manufacturers.

The future courses indicated for injection machine design will be directed mostly to the heating chamber. In order to obtain best results with all of the molding materials they must be thoroughly plasticised before entering the mold. As already mentioned, this has to be done with sufficient speed to allow reasonably fast molding cycles and while present chambers do an acceptable job, more refinement is necessary in establishing the proper combination of length, diameter and inside contour. While working along these lines attention has to be given to lowering the price of chambers so that molders can afford to have spares on hand to permit quick change over from one type of material to another.

Although high injection pressures are not much in demand at present, experiments are showing that definite improvements in physical properties of molded parts can be obtained using the materials which mold at lower pressures and injecting them at pressures up to 50,000 pounds per square inch. The full scope of this discovery will not be realized for some time but it means that machines will have to be built even heavier.

The mold makers are beginning to design their molds for use with forced evacuation in order to give greater ease of filling and prevent gas pocketing. Vacuum units now available, controlled by the automatic timing mechanism on the machines, have already shown remarkable improvement in the operation of existing molds from which it had always been difficult to obtain satisfactory pieces.

(Continued on page 64)

"LOGAN" CHUCKS ARE DESIGNED AND BUILT FOR ACCURACY AND HEAVY DUTY

ONLY "LOGAN" American Standard Chucks have all of these features:

1. ONE-PIECE ELECTRIC STEEL BODY —Cored for light weight and radially reinforced for extra strength. No screws to work loose and impair chucking accuracy or operating efficiency.

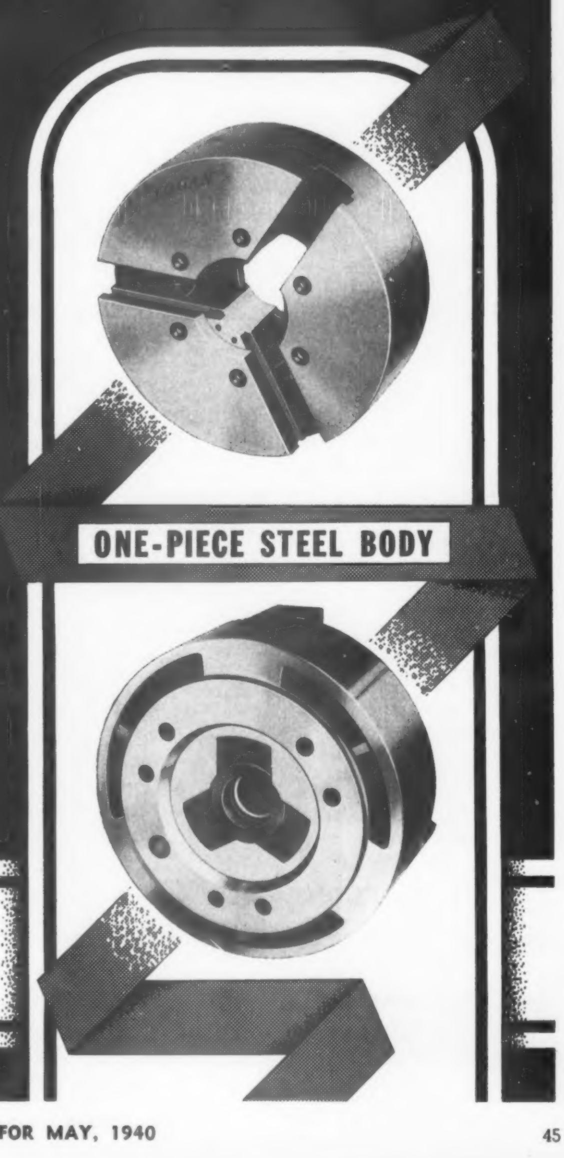
2. ALLOY STEEL INTERNAL WORKING PARTS—Heat treated for maximum strength. Extra large bearing surfaces to resist wear.

3. ALLOY STEEL MASTER JAWS — Hardened and ground. Cross jaw lock provides positive means for mounting false jaws.

4. POSITIVE DUST-PROOF SEAL—Constant contact between master jaw and under side of pilot bushing support.

5. ALEMITE LUBRICATION — Provided to lubricate all working parts.

Specify "LOGAN" Chucks for superior performance and positive chucking accuracy. Write for complete Chuck Catalog.



LOGANSPORT MACHINE, INCORPORATED
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Manufacturers of Air and Hydraulic Devices, Chucks, Cylinders, Valves, Presses and Accessories

PUNCHES FOR SMALL PRODUCTS

(Continued from page 19)

cost usually occurs on dies which involve swaging and shaving operations. In most cases the savings through the elimination of secondary operations will offset the increase in maintenance cost many times over and will readily justify their use.

The economy which can be effected through the use of progressive dies is too often overlooked. As a result too many parts continue to be manufactured on the basis of secondary operations.

High Production Dies for Secondary Operations
Single Station Dies

Single station dies for secondary operations have wide usage on pieces where part design makes the use of progressive dies impossible or impractical.

Single station dies for secondary operations, which are required due to design of the part vary in design from simple to complex. They are used with great frequency for piercing, shaving, trimming, forming, drawing and coining operations.

Piercing Dies—Second Operation

Piercing dies with solid strippers set a sufficient distance above the die to permit automatic ejection of work are recommended where part design will permit. The use of spring strippers is recommended for parts requiring close accuracy. When piercing punches are small they should be supported by bushings in the stripper. The stripper in turn should be supported by guide pins riding in bushings in the stripper.

Forming Dies—Secondary Operations

The two basic types of form dies are solid and pad type dies. The solid type is the least expensive to build. It is very effective when quality of form is required. It should not be used where the position of the form must be held accurately in relation to the contour or holes in blank. This is due to the blank leaving the locating device as soon as the forming action starts.

Pad type dies have wide application. The use of a spring pad which travels down during forming makes it possible to control the blank during the entire forming cycle. Whenever possible the locating members should be mounted on the pad. This feature is particularly desirable when location of form, in relation to contour or holes must be held to close limits.

The quality of the form can be held to close limits by using "side kickers" or wedges which set the form at the bottom of the stroke. The pad type die will handle all types of forms and can often be used to complete several in one operation.

Coining Dies

Coining operations have been performed on a variety of parts at the Endicott factory for the past 10 years. A great many of our coining operations are extremely simple; for example, producing hubs on levers or hubs on gears. A few of our coining dies accomplish difficult coining operations in which a severe displacement of stock takes place with the parts being held to close tolerances.

The construction of the details in coining dies differs radically from that in other types of dies. To start with, the die sets on the largest percentage of our coining dies are made of steel and are hardened. This is done to provide adequate support for the die and to prevent the block and punch from coining down into the shoe.

Die blocks and punches are made from high carbon high chrome steel. When making die blocks for severe coining operations, the impression in the block is produced by means of a hob under hydraulic pressure. We find that it is not practical to machine the impression as it will change its dimensions under the stress of coining. This change can be avoided by use of the hob. The impression should be given a slight amount of draft to facilitate the removal of the work. Nearly all coining dies require positive mechanical knockouts. Where necessary, knockouts are provided in both punch and die, the knockout in the die being cam operated by mechanism in the bed of the press.

In designing coining dies, arrangements must be made to permit the flow or escape of surplus metal. The part must never be completely confined as it is absolutely impossible to maintain dies on this basis. The coining opera-

(Continued on page 48)

PUNCHES FOR SMALL PRODUCTS
(Continued from page 46)

tion adds much stiffness or work hardness to the material. This often proves to be a desirable feature of the coining process. Tolerances of +.001 —.001" can readily be held on the thickness of sections which are coined.

The types of operations handled by coining may be classified as follows:

1. Coining to displace metal to produce parts having irregular cross-section.

2. Coining to size parts as a substitute for machining operations; for example, a substitute for grinding.

3. Coining to straighten pieces.

All three types of operations are in use at Endicott with the first and second types predominating. The advantages of the coining process are:

1. Rapid displacement of stock.
2. The ability to produce parts of varying cross-section and, therefore, to use shapes that otherwise would not be economically practical.
3. A reduction in the number of parts and elimination of sub-assembly operations.

The limitations of the process are:

1. Tool cost.
2. Its use limited to the softer tempers of steel and to non-ferrous metals such as brass, copper and aluminum.

Compound Dies for Secondary Operations

Compound dies for secondary operations should be used when 2 operations can be accomplished at one handling by using this construction. This is particularly true where the operations to be performed have a close relation. Combinations frequently found are as follows:

1. Piercing and shaving.
2. Shaving internal and external surfaces.
3. Drawing and piercing.

When shaving operations are involved the die block should be mounted on the upper shoe. We believe that this feature has the following advantages:

1. With the punch on the lower shoe and the die traveling down over the blank and punch, shaving chips are disposed of more easily and do not interfere with the accurate location of the part.

2. When the part has holes which can be used for locating purposes we believe it is a distinct advantage to have the locating pins mounted rigidly in the punch rather than mounted in a movable pad as would be the case if the die were on the lower shoe.

3. When it is necessary to locate the part by means of a nest it is possible to control the position of the nest to a greater degree of accuracy by mounting it on a spring pad which surrounds the punch. This spring pad is cleared all the way around the punch to permit rapid disposition of chips and is guided by means of two large pins riding in long bushings in the spring pad. In the making of shaving dies it should be noted that the die is so arranged that the direction of shaving corresponds exactly with the direction of blanking. In other words, the punch side of the part when blanked becomes the punch side of the part when shaved.

Index Dies—Secondary Operations

Considering the entire field of secondary operations on small parts, index dies have a small field of application. Whenever they are used we usually find one or more of the following conditions:

1. Tool cost—The need for repeating the same operation a number of times on one piece at an economical tool cost, particularly where ultimate production is small.

2. Handling cost—The need to carry a part through a series of operations at minimum handling cost which cannot be done in one die station and which could not be handled as easily from the strip.

3. Accuracy—The necessity to provide a degree of accuracy that could not be accomplished in a single station die, due to die hardening problems or to growth or distortion in the part itself.

4. Practical Die Construction — To make possible a die construction practical to build and operate and economical to maintain.

Secondary operation index dies are probably used more for piercing than
(Continued on page 68)

May Meetings . . .

BALTIMORE

May 13, 1940—Dinner 7:00 P. M. Regular Chapter meeting for members only. 8:00 P.M. Mr. Ford R. Lamb, Executive Secretary, speaker for the evening. Every member is urged to attend and make plans for this coming year.

For Dinner Reservation: Nils H. Lou, 3515 Glenmore Ave., Baltimore, Maryland. Phone: Hamilton 0851.

BUFFALO

May 16, 1940—Dinner 6:30 P.M., University Club, 546 Delaware Avenue. Technical Session 8:00 P.M.

Speaker: B. P. Schiltz, Engineer, Foot-Burt Company

Subject: "Modern Surface Broaching"

CLEVELAND

May 10, 1940—Dinner 6:30 P.M., Technical Session, 8:00 P.M. Allerton Hotel

Speaker: Dr. H. A. Grove, Stainless Steel Metallurgist, Republic Steel Company.

Subject: "Manufacture & Application of Stainless Steel." Talking Picture—"Republic Enduro."

Coffee Speaker—Ralph C. Mize, U. S. Weather Bureau, Cleveland, Ohio. "Talk on the Weather and Forecasting and Recording Instruments."

Dinner Reservations—Call W. T. Reiff, Jr., Cleve. Duplex Mach'y Co., Inc., MA-0112.

DAYTON

May 24, 1940—Dinner 6:30 P.M., Gibbons Hotel, Second Anniversary. National Officers expected to be present.

Speaker: G. J. Bates

Subject: "Better Methods"

There will also be exhibits and surprises.

DETROIT

May 9, 1940—Ford Motor Company, Administration Building Cafeteria, 3674 Schaefer Road, Dearborn, Michigan. Dinner, 6:30 P.M. sharp. Technical Session, 7:30 P.M. Trip through Tool and Die Plant, 8:30 P.M.

ELMIRA

May 17, 1940—Plant tour in afternoon of Ingersoll-Rand plant at Painted Post, N. Y. Dinner, 6:30 P.M., Ingersoll-Rand Restaurant. Technical session at 8:00 P.M.

Speaker: B. P. Schiltz, Engineer, Foote-Burt Company

Subject: "Modern Surface Broaching"

HARTFORD

May 6, 1940—City Club, Hartford. Dinner 6:30 P.M. Exhibition of model aeroplanes, courtesy Hartford Model Aeronautics Club. Technical session will include movies.

May 15, 1940—Third Annual Spring Outing at the Wampanoag Country Club. Hartford Chapter is offering a cup. Dinner at 7:00, followed by entertainment.

NEW YORK-NEW JERSEY

May 14, 1940—Dinner 6:30 P.M., meeting 8:00 P.M., Robert Treat Hotel, Newark, N. J.

Speaker: George Binns, Development Engineer, Cincinnati Milling Machine and Cincinnati Grinders, Inc.

Subject: "Centerless Grinding."

Reservation: Ben Brosheer, Medallion 3-0700.

PHILADELPHIA

May 16, 1940—Dinner at 6:30 P.M., Engineers Club, 1317 Spruce Street, Philadelphia. Real coffee speaker to be announced.

Speaker: W. T. Stegemerten, Supt. of Equipment, Methods, Westinghouse Electric and Mfg. Company.

PITTSBURGH

May 10, 1940—Dinner 6:30 P.M., Hotel Henry. Technical meeting 8:00 P.M.

Speaker: Fergus O'Conner, Maintenance Engineer of the Pittsburgh Plate Glass Co.

Subject: "Factory Maintenance as a Productive Medium instead of an Expense." Illustrated slides and a "Glass Brick Bank" souvenir for each who attends the dinner.

(Continued on page 54)

LOOKING AROUND

By Perry Scope

THERE are not over a half dozen people who know the identity of the writer of this column, hence my surprise the other day to have a certain executive say to me, "One gets the impression from reading your 'Looking Around' column that a Tool Engineer needs to be a complex person combining the mind of an executive, research engineer, student of time study, machine operator, and everything between." I replied, "You have summed it up in your usual terse, accurate manner."

After attending the technical sessions at the Annual Convention of A.S.T.E. in New York City, I am more convinced than ever that this is true. The Friday session conducted by A.S.T.E.er "Herb" Hall on "Tool Engineering Education" showed too, that many men realize the need for the development of that complex mind for the work of tomorrow.

When men like Clifford Stillwell, vice president of The Warner Swasey Company, go to the trouble and expense to develop such men, it shows the need is established and the correct trend is developing. Therefore, I was intensely interested in the discussion taking place after J. W. Barker, Dean of Engineering at Columbia University, and E. L. Bowsher, Superintendent of Toledo, Ohio schools, finished their splendid papers. I believe the discussion period took as much time as the symposium itself.

The need is definite in our town the same as in yours. Several young men in our chapter have approached me asking where they could turn for more advanced training in Tool Engineering. Yet here in our city that supports a college as well as technical high schools, nothing is offered to such ambitious fellows who haven't the funds to go to college. And even if they had funds available, there are only two or three colleges in the country that have even considered, (and only considered it) Tool Engineering as a science in itself. It is true that Mechanical Engineering does have courses in Machine Design, Strength of Materials, and Elements of Mechanics. Having labored through those college courses myself, I know how comparatively little use they are to a Tool Engineer. Therefore, in lieu of that, it would seem that if each chapter would build up a student chapter and develop its personnel along Tool Engineering lines peculiar to the companies in that locality, it could and would receive whole hearted support, even financial, from employers.

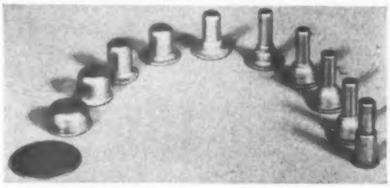
What group of men are in a better position to cooperate with company executives and educators to constructively criticize and advise than we of the A.S.T.E. We can make of Tool Engineering, a science—a Profession, if you will—comparable to any. I call it a profession, for that is the title it deserves. For some strange reason Engineers have never received the recognition now bestowed upon Doctors of Medicine, Dentists and others, and are not looked up to as are these men who are in a field that has had better press agents than we. It is strictly our own fault and we ought to do something about it. Don't misunderstand me; I wouldn't disparage any field or science as great as these. Men in those fields continue to save lives and increase longevity. All in all, they have done a wonderful work; but so have engineers in our commercial plants. Particularly is this true in this country.

Yet, does the Tool Engineer who designs safety devices receive proper credit for saving lives and limbs? What about the engineer who improves brakes, lights, power, tires, glass, etc., on automobiles, trains, airplanes, and other means of transportation? Who looks up to him in his community? Where is the honor, due the engineers

(Continued on page 65)

Carboloy Sheet Metal Draw Dies Still Operating After 7,200,000 Pieces

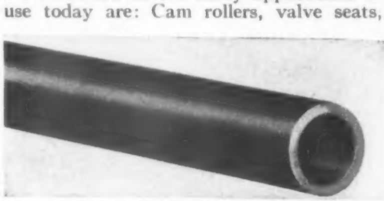
An example of the service obtained from Carboloy sheet metal draw dies is illustrated in an application at a mid-western plant. As shown below, a steel ferrule is formed in 10 passes from blank to finished ferrule.



Carboloy cemented carbide dies are used for 8 of the 10 passes. Dies have been in use continuously since April 1937, have produced 7,200,000 pieces since that time and are still operating. Carboloy die sizes in use for sheet metal drawing range up to 6" I.D.

Many Uses For Carboloy In Form of Hollow Cylinders

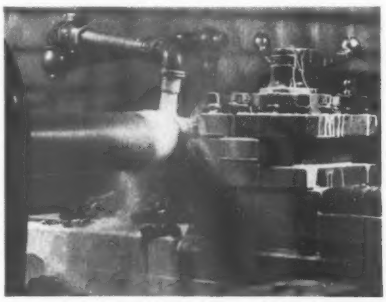
Many industries having problems of rapid abrasive wear on localized areas of machine parts, tools, etc., have found numerous uses for Carboloy in the shape of hollow cylinders. A few of the many applications in use today are: Cam rollers, valve seats,



spindle bearings, ring gage and large plug gage inserts, workrest bushings, burnishing punch bushings, punch die inserts, etc. When requesting information, state sizes, probable quantities, type of job and finish required.

Carboloy Tool Removes 38 Cu. In. Per Min. On S.A.E. 2350 Spindle Job at Monarch

One of the 2000 Carboloy tool applications at Monarch Machine Tool Company is the turning of S.A.E. 2350 spindle forgings, 36" long, 4" diameter. Set up on a 20" Monarch lathe equipped with 30 H.P. motor,



a Carboloy tool turns this forging at 300 f.p.m., feed of .020" per revolution. Maximum depth of cut ⅝". The operation is completed in eight minutes, removing 38 cubic inches of metal per minute. High speed steel tools formerly required 24 minutes. The Carboloy tool completes five forgings between grinds.

Recent Carboloy Literature Bulletin GT-120 containing complete data on steel cutting with Carboloy tools. Booklet GT-403 describing the general purpose use of Carboloy tools on 1500 small-lot applications at Warner & Swasey Company.

American Tool Engineers in the International Perspective

By S. KERSHAW

CANADIAN ACME SCREW & GEAR LTD.

Never was a moment more opportune to record the achievement of Americans in the cause of Peace and Tool Engineering. That this fact, kept in the background, requires limelight struck me when during our last Ontario Chapter meeting Mr. Smart rose to stress the benefit accrued to American Tool Engineering by the absorption of skilled engineers of the other Nations in its ranks. The story of American Tool Engineers contribution in the development of new industries in Europe, Australia, China, is yet to be told and will fill you with pride and interest.

American Tool Engineers were instrumental in the creation of Automobile, Aircraft, Telephone, Agricultural Implements, Radio, etc., plants all over the world. They introduced the manufacture of novel types of machine tools to England, Germany and France. Their activities extended to all fields of Engineering and large independent concerns like Skoda in Czecho-Slovakia were employing American Tool Engineers to further their production.

American Tool Engineers gave these far countries not only the benefit of their experience—they helped to spread U. S. ideas of Peace, Freedom and Equality of Opportunity.

Nothing illustrates the adaptability and efficiency of these fellow Americans better than a few facts as to varying engineering conditions prevailing, for instance, in Europe. The higher cost of gasoline requires the use of smaller consumption in engines. Specifications relating to electrical appliances differ considerably from those in force in America. The machine tools made had to conform to the altered design of the finished product to be machined. Different operating conditions had to be taken into account. Methods of building machine tools and to use them are at variance with U. S. routine. The fact that American Tool Engineers could produce men capable to master all these new requirements with great success is highly creditable.

Returning home from unruly countries these Ambassadors of Goodwill have settled down again to routine work in America. A few of them have consented to write a cursory account of their activities abroad.

MAY MEETINGS (Continued from page 51)

ROCHESTER

May 15, 1940—7:45 P.M., Lower Strong Auditorium, U. of R., River Campus.
Speaker: B. P. Schiltz, Engineer, Foot-Burt Company
Subject: "Modern Surface Broaching"

SCHENECTADY

May 13, 1940—8:00 P.M., Rice Hall of the General Electric Company.
Speaker: B. P. Schiltz, Engineer of Foote-Burt Company.
Subject: "Modern Surface Broaching."

SOUTH BEND

May 9, 1940—7:00 P.M. in the Oliver Hotel.
Speaker: Malcolm F. Judkins, the Firth-Sterling Steel Co., McKeesport, Pa.
Subject: "Firthite Sintered Carbide and Tipped Tools."

ST. LOUIS

May 9, 1940—Dinner 6:30 P.M., Technical meeting 8:00 P.M., Melbourne Hotel.
Speaker: Herman Zorn, V & O Press Co., Hudson, N.Y.

SYRACUSE

May 14, 1940—Dinner 6:30 P.M., Syracuse Industrial Club. Technical Session 8:00 P.M.
Speaker: Herbert Kennedy of Foote-Burt Company.
Subject: "Broaching and Broaching Tools."

TOLEDO

May 14, 1940—6:30 P.M. Hotel Willard.
Speaker: Attorney James Martin.


TOOLS TO FIT YOUR NEEDS
● NATIONAL Engineering and Manufacturing Facilities are geared to step right into your Metal Cutting Problems. Special toolings, such as shown here, are saving time and money thruout the Mechanical Industries.
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Tap and Die Division WINTER BROS. Wrentham, Mass.

A.S.T.E. DOINGS

(Continued from page 32)

submitted the names of eleven new members. They are: Hugh H. Wellman, William A. Turner, Harvey H. Klein, J. Frank Price, Donald C. Robinson, J. Corson Ellis, Earl T. Troendle, Philip M. Krick, George P. Weiland, Anthony Graf, and Ben Hoag.

Under its new chairman, C. T. Allen, the Chapter is looking forward to a fine year of continued progress.

The April meeting of **Elmira** Chapter was held at the Athens Plant of Ingersoll-Rand Company on Friday, April 12th. Plant tours were arranged for the afternoon. Dinner was served to 82 members and guests in the company cafeteria with 150 present to hear Walter K. Bailey of Warner & Swasey Company on "Telescopes and Turret Lathes". J. R. Blank, Chairman; C. D. Thomas, Vice Chairman; E. J. Carlton, Secretary, and Harold King, Treasurer, were installed as chapter officers for the coming year by John R. Lynch, the retiring chairman.

The April meeting of **Schenectady** Chapter No. 20 was held in Troy, N. Y. The W. & L. E. Gurley Co., graciously acted as host for the entire affair which included a tour of the Gurley plant in the afternoon and a dinner meeting followed by a technical session in the evening.

Our chapter is indebted to C. E. Smart, works manager of the Gurley Co. and one of the newly elected vice chairmen of Chapter No. 20, for his efficient handling of the arrangements for this affair.

In the business meeting following the dinner, the new officers for 1940 were installed. They are F. Diehl, Chairman; A. Schuneman, C. E. Smart and F. Naker, Vice Chairmen; D. G. Saurenman, Secretary, and R. H. Wilki, Treasurer.

E. W. Ernest, retiring chairman, expressed his appreciation for the co-operation given during his term of office.

At the technical session, which was held in the auditorium of the Gurley plant, W. K. Bailey of the Warner & Swasey Co., spoke on "Telescopes and Turret Lathes".

We wish to welcome to our organization, and to this column, the latest addition to our rapidly growing family—the **Boston** Chapter No. 33.

The newest member of our family got off to a flying start on the evening of March 28 with 82 charter members signed up, and if the attendance at the organization meeting is any indication of the future of the Boston Chapter, they should shortly be one of our larger chapters.

The organization committee has done an excellent job and deserves a great deal of credit for its work.

Officers elected for the Boston Chapter were Al Forbes, Chairman; C. A. Lockwood, Vice Chairman; W. W. Young, Secretary; J. Geddes, Treasurer.

Pittsburgh Chapter's April 12th meeting scored several "Firsts;" it was the first time they had gathered at the Hotel Henry; the first meeting at which new officers, headed by W. B. Peirce, officiated. The big first of the evening was the most fortunate and thorough work of Bill Owen, program chairman, in obtaining Mr. Everett Chapman, President of Lukenwald, Inc., of Coatesville, Pennsylvania, who delivered a technical session that the attending Tool Engineers found interesting, as well as instructive. Mr. Chapman spoke of Stress Distribution as Affected by Foundry Conditions; the Effect of Notches, Prick-Punches, Scratches or Lines and Design as to Residual Stresses; the Producing of Locked-Up Stresses by Thermal Transients.

Says Pittsburgh Publicity Chairman Bob Ford: "It was nice to have 'our Jim' back as just one of the boys in the chapter."

Installation of officers and the appointment of chairmen of the standing committees comprised the principal business at a dinner meeting of the **Tri-City** Chapter of the American Society of Tool Engineers held Wednesday evening, April 3rd, at the LeClaire Hotel, Moline, with about 130 attending.

J. B. Morganthall of the Tractor Division, John Deere Wagon Works, Moline, was installed as Chairman. He succeeds Otto Reller of the Moline Tool Company to the office. Other officers installed included J. E. Gilkrist of the

(Continued on page 58)

A.S.T.E. DOINGS

(Continued from page 56)

Walworth Company, Kewanee, Ill., as Vice Chairman; W. C. Fidler, Reynolds Engineering Company, Rock Island, as Secretary, and Kenneth Jasper, Rock Island Arsenal, as Treasurer.

Rockford Chapter No. 12 enjoyed another fine meeting on April 4th when it resolved itself into a Father and Son affair, sharing the meeting with both the "Rockford Gas Bugs," an organization of hobbyists interested in building and flying gasoline powered airplane models, and the Junior Engineering Club of Rockford High School. An exhibition of many beautiful jobs of model building resulted.

The menu committee experimented with a Swedish "Smorgasbord" instead of a regular dinner. Well, we're guessing that some of the members were other than Swedish. Immediately following the Smorgasbord the newly elected officers were installed by Ed Dickett, First National Vice President, then a fine talk on Hobbies was given by LaVerne Ryder. The speaker of the evening was Capt. Jack Knight whose timely topic was "Radio Highways of the Air".

April 1 was a banner meeting for **Hartford** Chapter and no April Fooling! An unusual dinner was held at the City Club. After the dinner, election of officers for the coming year took place, and the newly elected officers are as follows: Fred L Woodcock, Chairman; Henry Moore, Vice Chairman; Dick Miller, Secretary (second year), and Carl Moeller, Treasurer.

The technical session featured E. V. Crane of the E. W. Bliss Company, whose subject was "Plastic Working of Metals by Power Pressing", which was very instructive and was greatly appreciated by an audience of more than 300.

The high light of the meeting was the presentation of the National Membership Cup, as you can see from the picture that Ray Morris, Fred Woodcock, and Bob Englund are right proud of it, and we plan to keep it here as we like it so well. It's a challenge which reminds me that if you want to see it come to Hartford on May 15. We are going to have a gloating party at the Wampanoag Country Club, one of the best golf courses in New England. Golf all day and dinner in the evening, at which time Hartford is going to offer a cup to be competed for by teams from other New England Chapters. Plenty of prizes—and so we cordially invite every member of the A.S.T.E. to join us. Don't forget the date—May 15.

After its first annual dance **Los Angeles** Chapter started a spring term of meetings with the monthly dinner held at Scully's Cafe on March 28th. With the stiffness and formality natural to new organizations wearing away, the spirit of this meeting augured well for its place in the engineering life of Southern California.

With half of the evening turned into a symposium for the exchange of ideas a style of meeting has been arrived at which is bringing enthusiastic response.

F. H. Metke's black-board lecture on Gear Design followed by a question and answer period handled by F. Anderson climaxed an exceptionally fine color film shown through the courtesy of the Cincinnati Milling Machine Co. This film on "The Physics of Metal Cutting", explained by Wendell H. Kinney, drew many questions which were answered by Wm. Siebert of the above mentioned concern, and Roy T. Weise of the Union Twist Drill Co.

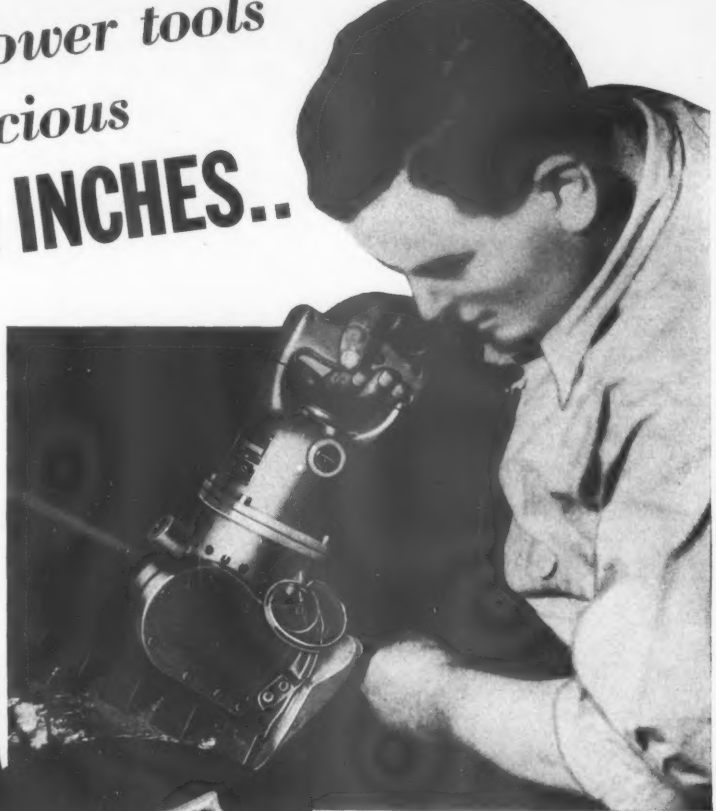
Worcester Chapter held its April dinner meeting on Monday night, April 8, at the Putnam & Thurston's Restaurant. Approximately 120 members attended the dinner and meeting.

After the dinner, our newly elected officers were installed in their offices, and after the installation ceremony, our National President, A. H. d'Arcambal, spoke, giving a brief summary of the Society's history and rapid growth.

The Springfield Chapter was represented at our meeting by its Chairman, Vice Chairman, and Treasurer, Frank Curtis, M. J. Brennan, and Ed. Shelden, respectively. Boston was represented by its Secretary, Bill Young. Hartford was represented by its Vice Chairman, Henry Moore, and by the speaker of

(Continued on page 60)

Cost-paring power tools save precious OUNCES *and* INCHES..



2400 sheer cuts per minute in 18 to 12 gauge hot rolled steel is rated performance for Stanley Unishears. Three sizes of portable Unishears are produced by Stanley Electric Tool Division, New Britain, Conn., for straight, angular or curved cutting. To provide reserve strength and toughness, to absorb shocks and stresses of high speed operation, to resist wear and maintain accuracy, Stanley specifies worms, yokes, armature shafts and blade screws in SAE 2335 3½% Nickel steel, SAE 4640 Nickel-molybdenum and SAE 3135 Nickel-chromium steels respectively.

...by utilizing NICKEL alloy steels.

Competition for lower production costs has speeded up shop operations, forced the use of higher speeds in power-operated hand tools. For conveniently compact designs, fatigue-saving lightness and a safeguard against breakage, Nickel alloy steels are generally specified by tool designers. Skilsaw, Inc., makers of rotary saws, drills and grinders, uses a case-hardened SAE 4615 Nickel-molybdenum steel for shafts and worms. Skilsaw gears are SAE 3120 Nickel-chromium steel. Hobbed shaft gears are SAE 4615 Nickel alloy steel —for strength where stress comes.

This 2 lb. air turbine grinder, scarcely bigger than your fist, operates at 50,000 RPM. Modern equipment, such as this Onsrud grinder, pares down costs of die finishing, precision milling and internal grinding. High speeds are practical because of the increased strength and toughness of Nickel alloy steels. For the highly stressed spindle of this versatile grinder the Onsrud Machine Works, Chicago, uses cold-drawn SAE 3135 Nickel-chromium steel. This bar stock, furnished by Super-Steels, Inc., is heated to 1450° F., quenched in oil, and tempered at 800° F. to develop a tensile strength of 175,000 p.s.i.

• • •

Have you written for your free copy of "Nickel Steels, Nickel Cast Irons and Non-ferrous Nickel Alloys for Modern Production Equipment"?

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

A.S.T.E. DOINGS

Continued from page 58)

the evening, Clinton Johnson. Mr. Johnson, who is Chief Gage Engineer of the Gage Division of the Pratt & Whitney Co., spoke on the subject of Gages and Gaging. His talk was supplemented by slides showing many different types of gages and their application. The members were deeply interested and gave Mr. Johnson a rising vote of thanks.

The **Toronto** Chapter held its monthly meeting on the 12th, in Toronto, at the Oak Room of the Union Station.

Mr. I. J. Snader of Excello Corporation, Detroit, spoke on "Thread Grinding" and we had one of the largest groups so far this year.

The subject, of course, is of vital interest now, because of the British government specifications on Gauges for War work, etc., and all the local industries that are engaged to any extent had representatives present, and kept Mr. Snader busy for an hour answering questions.

The next meeting is going to be at Hamilton, on May 10th, and a letter has been sent to each of the members with a form, on which they have the privilege of asking a question. This question will be answered at the May meeting, and for this reason the May meeting's name is "Ask Another".

The second annual bowling party of the **Rochester** Chapter was held Friday, April 5th at 22 North Washington Street, Rochester. Approximately 200 members and guests attended. Every one indulged in at least one round of bowling.

The committee is to be congratulated on the whole program as the complete arrangements were fine in all details. Much favorable comment was given to the fine luncheon which was served at the end of the affair.

The Rochester Chapter's Board of Directors met on Monday, April 8, at the Hotel Sagamore and went over plans for the ensuing year. Considerable discussion concerning new methods for inducing added attendance absorbed much time during the evening. Plans concerning the program for the coming year, discussion concerning the student membership, as well as meeting place, brought out many comments from those attending. Most of these matters have been put into the hands of the committee for further discussion at the next Directors' meeting.

The regular monthly meeting was held at the University of Rochester on the evening of Wednesday, April 10th. The speaker scheduled to talk was unable to keep his appointment, so Mr. Elmer Keech of Warner & Swasey substituted. The speaker provided interesting pictures and confined most of his talk to the subject of telescopes.

The gathering was not as large as had been expected, approximating only about 100.

Milwaukee Chapter's April gathering heard Mr. E. O. Rutzen, former Chairman of that body and now Sevond Vice President of the National Association, give a brief resume of the highlights of the annual meeting held at New York.

The new officers of the local chapter took their oaths of office according to the new by-laws of the Society.

Mr. David Cameron of the McCaskey Register Company delivered an interesting, illustrated address on modern tool crib control methods. Questions and controversial points were answered in a discussion that followed.

"Diamonds" was the subject of Mr. Charles M. Johnson, who is an expert in this field. Many things not generally known about this important industrial product were brought out and discussed.

Mr. Arthur Johnston, member of Milwaukee Chapter of the A.S.T.E. and representative engineer in this district for the Greenfield Tap & Die Co., passed away April 11th, 1940, 2:30 p. m., at his home. Mr. Johnston was ill only a short time.

New officers were sworn in at the April meeting of **New York-New Jersey** Chapter No. 14. Herb Hall, who did a swell job in connection with the annual meeting in New York this March, relinquished the reins of office to Wally

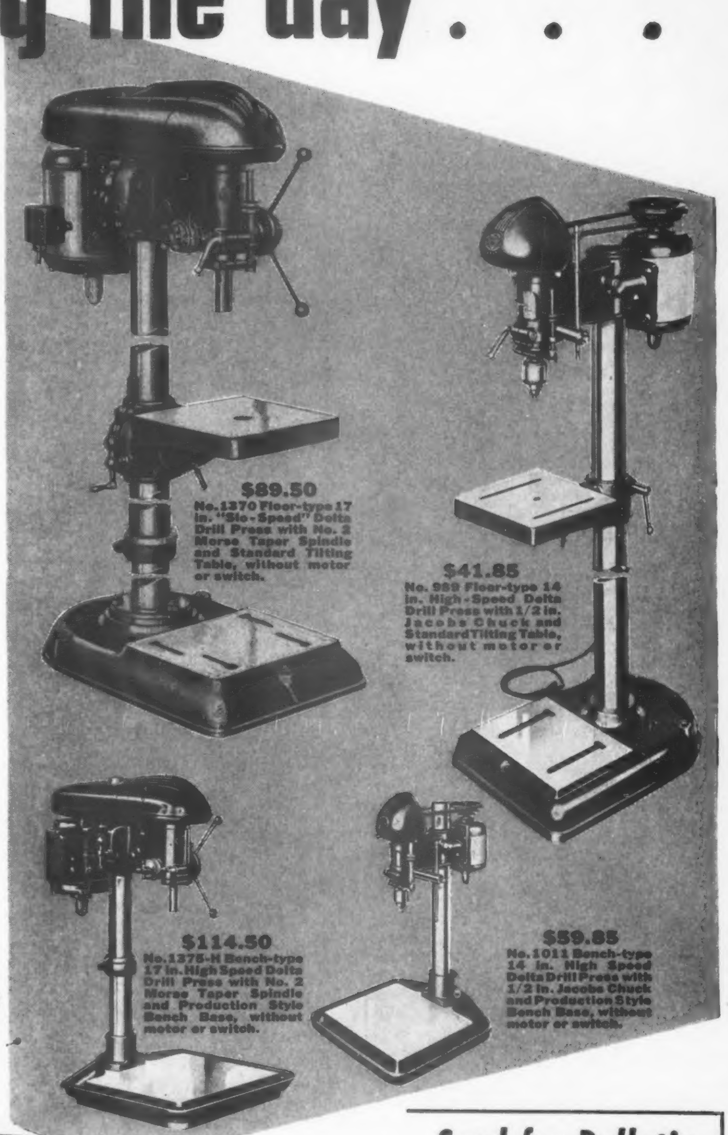
(Continued on page 64)

"These new Drill Presses are saving the day" . . .

Production men everywhere tell us that the wide range of Delta low-cost 14" and 17" drill presses are saving their hides by enabling them to reduce costs and speed up drilling and tapping operations without a heavy investment. Many shops use Delta drill presses in batteries of from five to twenty on straight production work, in addition to using them in the toolroom and general machine shop. They can be installed in a few minutes anywhere they are needed, can be used to supplement multiple-spindle machines where additional spindles are required, can be adapted easily and cheaply for special operations, replacing expensive single-purpose machines. Their many exclusive and built-in improvements have led to their adoption by thousands of manufacturers as standard production tools. And—you can get immediate delivery on them!

Ideal for Special Set-Ups, Too!

In addition to their use as standard drill presses, the heads, columns and flanges, of these machines may be purchased as separate units so that special set-ups can be made. Their low cost makes them more economical than anything that can be made up in the toolroom or machine shop. The heads can be used in any position, vertical, horizontal or angular, because their self-sealed ball-bearing construction eliminates all lubrication problems. Photographs sent in to us, showing special set-ups with Delta drill press parts, reveal how a little ingenuity can lick a tough job at a worthwhile saving in tool costs.



$89.50
No. 1370 Floor-type 17 in. "Slo-Speed" Delta Drill Press with No. 2 Morse Taper Spindle and Standard Tilting Table, without motor or switch.

$41.85
No. 989 Floor-type 14 in. High-Speed Delta Drill Press with 1/2 in. Jacobs Chuck and Standard Tilting Table, without motor or switch.

$114.50
No. 1375-H Bench-type 17 in. High Speed Delta Drill Press with No. 2 Morse Taper Spindle and Production Style Bench Base, without motor or switch.

$59.85
No. 1011 Bench-type 14 in. High Speed Delta Drill Press with 1/2 in. Jacobs Chuck and Production Style Bench Base, without motor or switch.

No. 1555—17 in. Four Spindle "Slo-Speed" Drill Press, with No. 2 Morse Taper Spindles. Available in High Speed or with ½ in. Jacobs Chucks.

Send for Bulletin

Fill out and mail coupon for Special Drill Press Bulletin giving full details, description and prices of the complete line of Deltg Drill Presses.

DELTA *Mfg. Co.*
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Gentlemen: Please send me your latest Drill Press Bulletin which contains specifications and prices of your complete line of Drill Presses.

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MOLDING PROCESSES

(Continued from page 42)

cedure does not vary much from what has been described.

Transfer Molding

So far we have discussed only one type of molding. It has been the compression type. At present, a very large percentage of molded articles of the resinous type are made by this compression method. There is still another process known as transfer molding. This method, in most cases, is carried on in the conventional type of compression press. But the method requires special mold designs. The principle is similar to that used in the die-casting industry—transferring a hot metal into a chilled die. However, in plastics, we transfer a plasticized compound from a loading chamber into a heated mold and in this heated mold the completion of the curing occurs. As the compound is entering the closed mold through a small orifice which is well supplied with heat, it affords a condition which is quite favorable—by uniformly heating all the compound before the final follow-up pressure is applied. This method is very desirable where exceptionally delicate die sections are necessary—also where small inserts are involved in the molding process.

There is much experimenting with this Transfer Molding procedure from Thermo-Setting materials at the present time and, what the outcome will be, is anyone's guess. However, some think that the injection of Thermo-Setting materials will be just as popular as the injection of Thermo-Plastic Materials, about which you will hear later.

A.S.T.E. DOINGS

(Continued from page 60)

Gray who won his spurs last season as able chairman of the program committee. Wally appointed Frank Malhiot to that important post. Frank was responsible for the fine showing the chapter made in the membership drive last year—missed the cup by a hair—but that wasn't Frank's fault. The 82 members he added represented the highest number of new members brought in by any chapter last season. Many other committee appointments were also announced: Membership, Wilson Ryno; publicity, Bob Crannell; speakers class, Frank Byrne; standards, C. L. Thomson, and industrial relations, Frank Sheeley, the good old standby.

Technical speaker of the evening was R. H. Rogers of the General Electric Co., who genially illustrated how electrons whizz around in vacuum tubes and how such gadgets can be worked into machine control circuits. Considering the complexity of his subject, the speaker did a fine job in simplifying the presentation of goings on in the field of electrical engineering that Tool Engineers should know about.

Cleveland Chapter's April 11th meeting was held at the Hotel Allerton, 109 members and guests attending the dinner. Retiring Chairman, Mr. Jack Hawkey, introduced newly elected officers: C. V. Briner, Chairman; R. B. Oswell, Vice Chairman; W. T. Reiff, Secretary, and W. R. Wyatt, Treasurer. Mr. Hawkey was slightly embarrassed when he discovered that he didn't have the gavel to turn over to his successor (it had been missing ever since he went to Florida). New Chapter Chairman, "Clete" Briner, gave a brief history of the rapid growth of the A.S.T.E., and stated that his administration had two definite objectives in mind. One, to double the present membership and, two, to double the average attendance at meetings during the coming year. Chairman Briner also reported on the National Annual Meeting in New York, stressing the Society's advances.

INJECTION MOLDING

(Continued from page 44)

Saved for Discussion

The future of injection molding based on the conclusions which can be drawn from this discussion and the general opinion of everyone connected with the plastics industry, seems destined to be that of a process which will be of major importance to almost all other industries within the next five years.

Binders for a whole year for THE TOOL ENGINEER, attractively stamped with volume number and publication name—$1.25. Write for yours, now.

GENERATING SMALL GEARS

(Continued from page 12)

asked at the beginning of this article, that is, if the principles demonstrated by the model can be applied to cutting teeth by a machine it will be truly generating.

This machine (Figure 15) can also

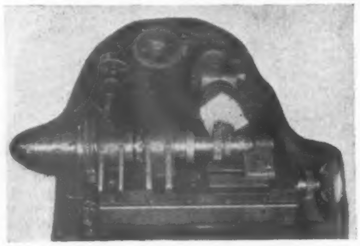

Figure 14

rectify gears after hardening either by controlled pressure rolling or by controlled laps using compound or a lap impregnated with diamond dust. Pressure rolling with oil has been found very satisfactory, provided that the heat treat distortions and other errors are not excessive.

The cutting and finishing of teeth is only one phase of producing precision gears.

The precision starts with correct design of each pair of mating gears.

The selection of the material and its correct treatment.

The accuracy of the blank, particularly squareness, parallelism and concentricity.

Methods of holding.

Distortion under cutting.

Distortion under heat treat.

Distortion under running load.

Methods of housing.

All have their effect on the final product.

LOOKING AROUND

(Continued from page 52)

responsible for prolonging the lives in our homes through the development of safer, low-cost appliances, resulting in easier, more pleasant work, purer foods, and better sanitation? Unfortunately there is a dearth of the proper honor for these men because they are altruistic enough to be satisfied with "Well done thou good and faithful servant" and so they tackle the next need.

Let's go after student chapters and help the youngsters. Let's get courses started in schools and colleges so that someday there will be a title of "Doctor of Tool Engineering."—*Perry Scope.*

NEW EQUIPMENT

(Continued from page 28)

ing principles of the modern methods for correction, as employed by the Gisholt Machines. Copies of this illustrated 32-page booklet are available from Gisholt Machine Company, 1229 East Washington Ave., Madison, Wis.

Industrial Relations Committee A.S.T.E.

PERSONAL SERVICE FOR MEMBERS

SITUATIONS AVAILABLE

Draftsmen, Detailers, and Layout Men, vacancy in Detroit, good work, and chance for advancement for the right men.

Experienced machine tool inspector with the background of thorough machine shop or tool room training, or a young machine tool engineer who is willing to work with test instruments, required to work on the inspection and acceptance of finished machines and the tooling that goes with them.

Also a mature man with broader experience to supervise the work of a few men of the above type and to do similar work himself. The locations for the above work are in the Connecticut valley, in Cincinnati, or in Milwaukee. The senior men and some of the junior men would have some traveling to different shops with expenses paid.

Tool and Die Engineer—35 to 45 years of age to work on the design and development of new precision punches and dies for simple, compound, and progressive operations on presses used in the fabrication of small, intricate, close-tolerance metallic parts. Location, Northwestern Pennsylvania.

Shop foreman or superintendent required by small shop in Southeastern Texas. Must have, thorough knowledge of tool work and tooling requirements, and of estimating. Executive ability; systematic organizer. Technical education desirable. Actual shop experience. Age 28-48 years. Tool design experience not necessary. Applicant should be capable of taking complete charge of shop, and will be given full authority therein. Contract will be given if required, and opportunity to participate or acquire interest after reasonable try-out.

SITUATIONS WANTED

Man with seventeen years experience which includes tool designing, tool design supervising, industrial engineering and plant superintendent work, available for supervisory work.

Man with twenty years experience which includes machine shop superintendent and production superintendent work is desirous of obtaining supervisory position.

For further information contact or write to American Society of Tool Engineers, 2567 West Grand Boulevard, Detroit, Michigan.

PUNCHES AND DIES— SMALL PRODUCTS

(Continued from page 48)

any other operation. In most cases the reason will be either tool cost or die construction or a combination of both.

We have an interesting example of a die of this type which pierces 1,416 rectangular holes in a brass sheet 4" wide 15" long and .025" thick. There are 8 rows of holes with 177 holes in each row. The die pierces one hole in each row and indexes 176 times. The reasons for building this die were tool cost, accuracy and practical die construction.

Another interesting index die, pierces and shaves 80 holes in 3 different parts holding a tolerance of .0002 on size of hole produced. A third die is used to carry a part through a series of 5 operations in which it is pierced, swaged, trimmed, and first and second shaved. The reason for building this die was to reduce handling cost. It also accomplished a marked reduction in manufacturing cycle.

The problem of handling or operating should be stressed in all second operation dies. Methods of loading, locating, ejection, and cleaning should be as efficient as quantity of parts to be produced will permit. Provision should also be made for safe operation by loading outside of the working area or by using mechanical loading devices.

PUNCHES AND DIES—A DISCUSSION

(Continued from page 24)

you will readily understand that after a very careful check with the lowest ultimate part cost in mind the predominant type of die in our plant is the compound die for primary operations, and for secondary operations the single stage die or single or multiple function. So with the same method of selection our set-up is placed at the operation end. From Mr. Forde's case it was very obvious according to his paper that the progressive type of die is predominant at the plant where he is employed. This wide difference is caused by the different conditions in the two plants.

There may be some of you who have a parallel set-up with the International Business Machines Corp., and others who parallel our set-up. But each one of you will find your proper place between these two extremes; the determining factors are your particular type of product, the amount of production, the physical shape of the part, and your allowable tolerances, provided, when you figure your layouts, you do it impartially, without prejudice to any type of die, and with the thought in mind of the most important factor of all, the ultimate lowest parts cost.

Write A.S.T.E., Detroit, for your copy complete Convention papers. Priced to members at $1.00 each.

NIAGARA MASTER SERIES "A"

OPEN BACK INCLINABLE PRESSES . . . .

SIZES FROM 1¼" TO 6½" DIAMETER SHAFTS

This line-up of Niagara Master Series "A" Inclinable Presses shows how the complete, well-graduated range of sizes offers the correct machine to fit every job. Advanced engineering features include strong rigid frames, instant acting 14-point engagement sleeve clutch with built-in single stroke mechanism, slides operate in multiple "V" gibs for accuracy and long die life, breech block die clamp, easily operated one-man inclining device. Write for Bulletin 58-H.

NIAGARA MACHINE AND TOOL WORKS BUFFALO, N. Y., U. S. A.

BRANCHES: General Motors Bldg., DETROIT — Leader Bldg., CLEVELAND — 50 Church St., NEW YORK

Good reasons for a good name

You who depend on hollow screws to "hold things together,"—you depend on tests so long as *you* do the testing. Beyond that, you depend on the good name of the screws.

For a good name, you know, is established not by any test or series of tests, but by meeting the tests of practical *use* under all shop conditions, over a long term of years. Yes, 30 years in the case of your ALLENS!

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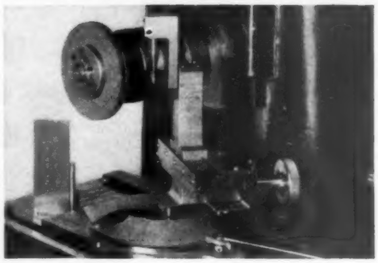

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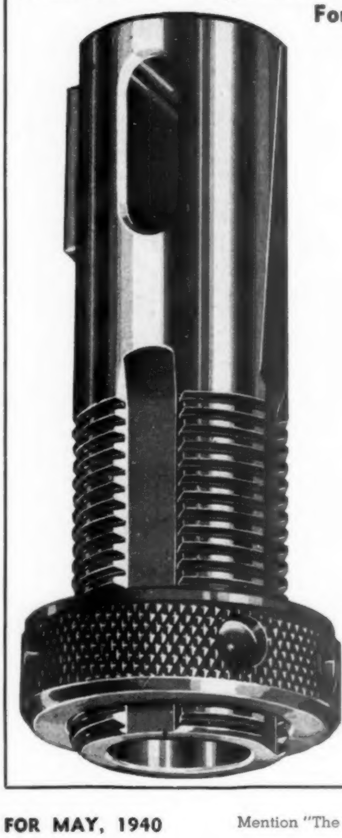

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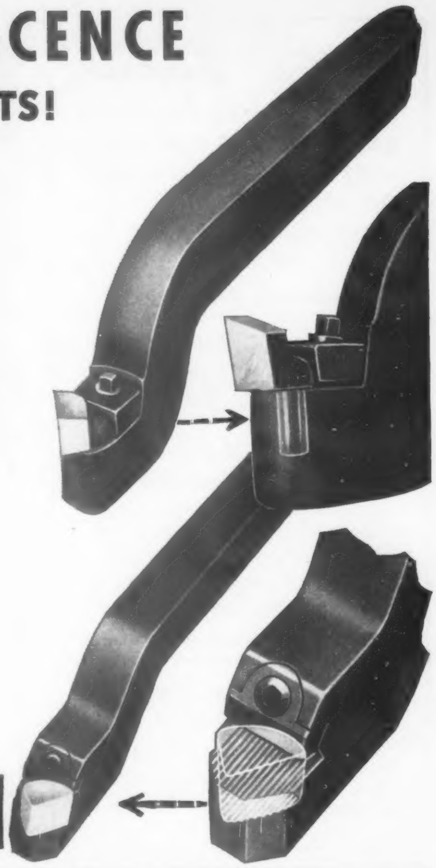

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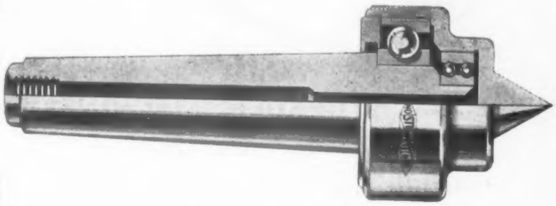

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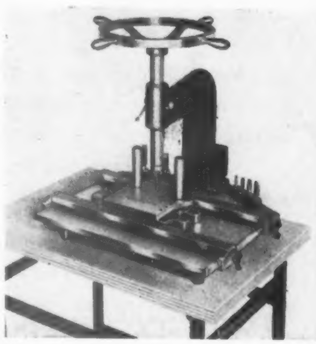

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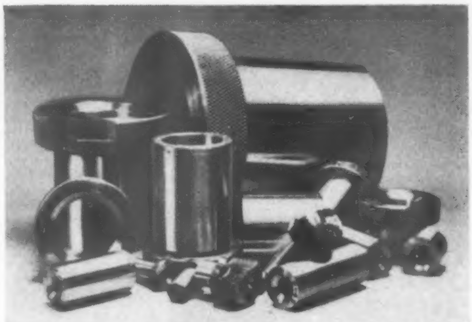

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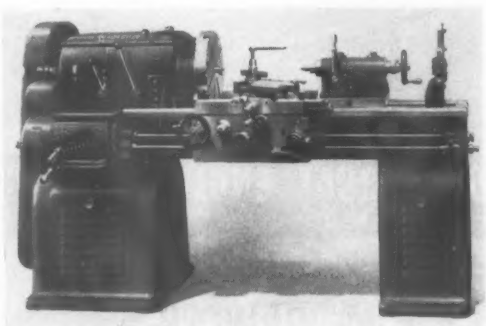

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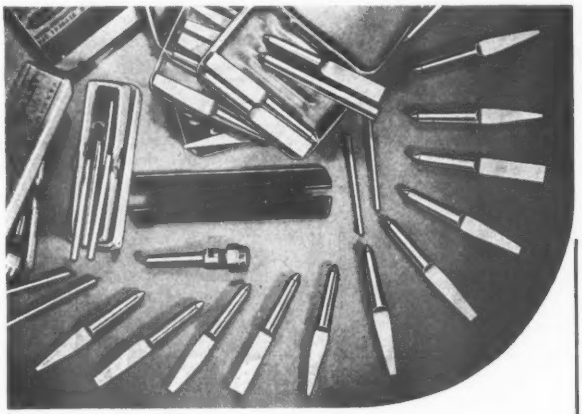

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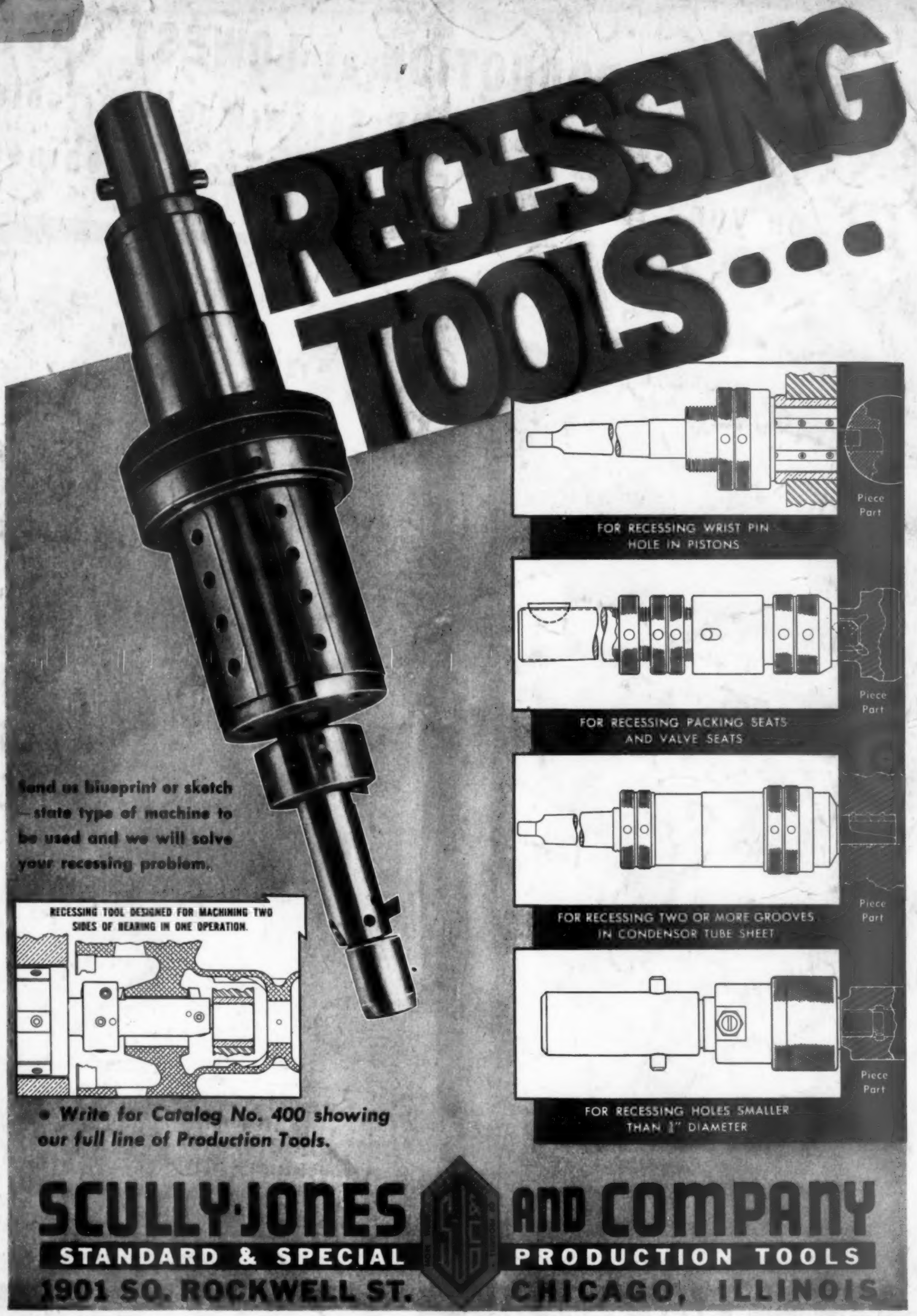
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